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Final Environmental Impact Statement

for the Malheur, Umatilla, and Wallowa-Whitman National Forests Land Management Plans

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Biological Environment

Aquatic Species Diversity and Viability

Changes Made Between the Draft and Final Environmental Impact Statements

Aside from the global changes throughout this environmental impact statement described in the Preface to this document (see Volume 1), the following changes were made specifically to this section:

Changes to the Aquatic and Riparian Conservation Strategy (ARCS): The following discussion has been added here in response to a public comment on the Draft Environmental Impact Statement.

The Purpose and Need section of Volume 1 explains the reason for integrating some form of an ARCS in each action alternative. Both the 2008 Regional ARCS and the 2018 Blue Mountains ARCS contain five essential elements, which have been developed as parts of the Plan and each of the action alternatives: desired conditions, standards and guidelines, development of restoration objectives, a monitoring plan, and riparian management area standardized widths. The 2018 Blue Mountains ARCS is consistent with national agency planning direction, and revised and clarified specific elements of the original 2008 regional ARCS. The essential elements of the 2008 Regional ARCS were incorporated into Alternatives, B, C, D, E, and F and were described and contrasted by alternative in Appendix A in the 2014 Draft Environmental Impact Statement. Those alternatives still incorporate the elements of the 2008 Regional ARCS as previously described in 2014. The 2018 Blue Mountains ARCS has been incorporated into two additional alternatives Alternative E-Modified and Alternative E-Modified Departure. The 2018 Blue Mountains ARCS for the Revised Forest Plans (Alternative E-Modified) is included as Appendix A in each Forest Plan and is considered part of the Plan for analysis and decision purposes.

The 2018 Blue Mountains ARCS includes additional information about the scientific basis for the various ARCS elements, their purpose and how they would be applied during implementation. Appendix H of the Biological Assessment (located in the planning record) provides the scientific basis for the most recent iteration of a new forage utilization standard for Alternatives E-Modified and E-Modified Departure, known as GM-3G.

The updated analysis for aquatic species considers effects of implementing elements of the 2018 Blue Mountains ARCS under each of the two additional alternatives, relative to effects of implementing PACFISH and INFISH for Alternative A, and relative to effects of the 2008 Regional ARCS as it would be variously implemented under Alternatives B through F. The Blue Mountains Aquatic Sustainability model used for the effects analysis accounted for alternative-specific changes to land allocations for riparian management areas and other management areas, suitable uses, current riparian and upland vegetation conditions, aquatic habitat conditions, road density and road proximity to streams, current livestock use levels, and the associated risk to aquatic species used as surrogates representing all aquatic species and effects of these major land uses that affect aquatic species diversity within National Forest System lands.

Updated tables and comparisons of effects of alternatives based on active restoration objectives for all the alternatives and the degree to which each alternative is likely to restore aquatic habitats in key and priority watersheds and other subwatersheds as opportunity presents, across each

national forest, based on updated analyses of restoration objectives, conducted per the Aquatic Sustainability Model (documentation in the project record. See the “Watershed Function, Water Quality, and Water Uses” section for methods and additional effects analyses).

Changes in Species Classification Labels: Some terminology has been changed between the Draft and Final Environmental Impact Statements to reduce confusion and provide updates based on best available scientific information. The Draft Environmental Impact Statement referred to “species of conservation concern,” which has a specific definition and process for selection under the 2012 Planning Rule that is not applicable to plans revised under the 1982 Planning Rule. To avoid confusion with the 2012 Planning Rule and its implementing regulations, “species of conservation concern” is not used in this Final Environmental Impact Statement. See the Preface of Volume 1 for more information and the species category definitions in the “Terrestrial Wildlife” section under “Regulatory Framework” on page 228.

Changes to Labeling Species as “Focal” and “Surrogate” Species: Discussion has been revised to clarify that the aquatic species referred to as “focal” species in the Draft Environmental Impact Statement are actually serving two different functions. Their role as species representing larger groups of species with similar patterns of habitat use, distribution and/or life history characteristics, was used in the species viability modeling and comparison of alternatives. When used in that sense, those species are now described as “surrogate” species in the Final Environmental Impact Statement. Describing the representative species as “surrogate” species indicates their use in representing other aquatic species with similar habitat requirements, similar seasonal habitat use patterns and overlapping geographic distributions, for purposes of analyzing effects of alternatives on overall viability of aquatic species in the Plan Area. Their designation as “focal species” indicates that habitat trends for these same species will be monitored.

Updates to the Existing Condition Section: Fish distribution and population information for the selected surrogate species was reviewed and updated from Streamnet, current Forest Service GIS fish distribution data layers, best available information from U.S. Fish and Wildlife Service, National Marine Fisheries Technical Teams, federally listed species Status Reviews and Recovery Plans.

Additional detail regarding the 2008 U.S. Fish and Wildlife Service citation referenced in a footnote to Table 242 on page 25 was provided for clarity, together with a supporting citation.

Analysis for essential fish habitat has been dropped for salmon in the Walla Walla and John Day River subbasins in the Plan Area, based on final designations by National Marine Fisheries Service in 2014 per the Magnuson-Stevens Act after the Draft Environmental Impact Statement was provided for public comment (79 FR 75449, Dec 18, 2014). Analysis under the Magnuson-Stevens Act is only required for Pacific salmon in the subbasins where Essential Fish Habitat has been designated per the Federal Register. Table 237, Table 238 and Table 239 in this section were updated to reflect changes to Essential Fish Habitat geographic designations for Pacific salmon. Those changes took effect in December of 2014, after the Draft Environmental Impact Statement was published.

Updates to the Environmental Consequences Section: Assumptions and data underlying the aquatic species model protection scores were reviewed, updated, and recalibrated, as were calculations for numbers of priority, key and all watersheds improved over 10 and 20 years, resulting in updated and expanded tables for improved watershed conditions. The Aquatic Sustainability model was re-run for all alternatives. The methods used for the model, including the recalibrations, are described in the “Watershed Function, Water Quality, and Water Uses”

section in Volume 1. Model calculations and summaries for watershed condition improvements are available in the project record.

Model protection evaluations for the alternatives were updated in tables. Effects analyses based on relative degrees of protection and passive restoration, as represented by protection evaluation metrics, were added for Alternatives E-Modified and E-Modified Departure. Analyses for all alternatives were updated based on results of new model runs.

Key and priority watershed information in Table 245 was updated, based on watersheds being added or dropped from the Key and Priority Watershed lists previously presented in Appendix B of the Draft Environmental Impact Statement. The final key and priority watershed lists are provided in Volume 4, Appendix A.

Changes in Terminology used for Aquatic Species: Some terminology has been changed between the Draft and Final Environmental Impact Statements to reduce confusion and provide updates based on best available scientific information. Both the terrestrial and aquatic sections of the Draft Environmental Impact Statement referred to “species of conservation concern,” which has a specific definition and process for selection under the 2012 Planning Rule that does not applicable to the plans revised under the 1982 Planning Rule.

- **The term “species of conservation concern”** as used in the “Aquatic Species Diversity” section of the Draft Environmental Impact Statement, was intended to serve as an all-encompassing phrase that included federally listed species, Forest Service sensitive species, and any other species with viability concerns. That all-encompassing phrase will not be used in the aquatic species section of the Final Environmental Impact Statement to remove any confusion as to which Planning Rule is being used. Additional clarifications on terminology between the Draft and Final Environmental Impact Statements are as follows:
- **Surrogate Species in** the Draft Environmental Impact Statement were referred to as “focal species.” The name was changed to “surrogate species” for analysis of alternatives, to avoid confusion with “focal species” as defined in the monitoring program requirements of the 2012 Planning Rule.

  Surrogate species serve an umbrella function in terms of encompassing habitats needed for other species, are sensitive to the changes likely to occur in the area, or otherwise serve as an indicator of ecological sustainability. The long-term sustainability of a surrogate species is assumed to be representative of a group of species with similar ecological requirements and this group is assumed to respond in a similar manner to environmental change (Suring et al. 2011). Spring Chinook salmon, steelhead, bull trout and redband trout are the designated surrogate species used to analyze effects to other aquatic species with viability concerns in the Plan Area.
- **Management Indicator Species** – The Draft Environmental Impact Statement stated that only Alternative A was analyzed for management indicator species. The Draft discussed the ineffectiveness of past efforts at monitoring population trends for the aquatic management indicator species identified in the 1990 Forest Plans. No suitable alternative species were identified as useful aquatic management indicator species for the revised plans in the Draft Environmental Impact Statement. The original management indicator species as well as possible replacement native and desirable non-native vertebrate species were reassessed for suitability as management indicator species between the Draft and Final Environmental Impact Statements. In addition, monitoring metrics identified in the 2012 Planning Rule as useful for population monitoring were reviewed further. After that reconsideration, a

modified set of management indicator species is now being analyzed for the plan revision alternatives.

- **Focal Species** – This discussion is added for clarity as to how focal species would be used in the revised Plan. Although this plan revision was developed under the provisions of the 1982 Planning Rule, it is required that all land management plans be updated and include a monitoring strategy that addresses the status of focal species as directed in the 2012 Planning Rule (36 CFR 219.12 (c)(1)). Focal species are not intended to be a proxy for other species. Instead, they are species whose presence, numbers, or status are useful indicators that are intended to provide insight into the integrity of the larger ecological system, the effects of management on those ecological conditions, and the effectiveness of plan components to provide for the diversity of plant and animal communities. Spring Chinook salmon, steelhead, bull trout and redband trout are the designated focal species in the Monitoring Plan.

See the applicable laws and regulations under the "Regulatory Framework" section that follows. These categories fully comply with the 1982 Planning Rule, the National Forest Management Act, the 2012 Planning Rule monitoring program development (CFR 219.12), national policy for Forest Service Sensitive species, the Magnuson-Stevens Act, The Endangered Species Act and the obligation to use best available science. It is important to note that a species can fall within one or more of the categories defined, but also that portions of a species may fall in one category, while another portion of the species may fall in a different category. For example, spring Chinook salmon as a whole, serve as both a surrogate species and a focal species; serve as a management indicator species for all the plan revision alternatives (but not for Alternative A); all spring Chinook salmon are covered under the Magnuson-Stevens Act except for those in the John Day and Walla Walla River subbasins; and only the Snake River group of spring Chinook salmon is federally listed (see Table 237, Table 238 and Table 239 on pages 9-11).

The climate change discussion was condensed and updated, incorporating recent research and literature pertinent to surrogate species viability in the Plan Area (USFWS 2015, Isaak et al. 2017, Clifton et al. 2017).

Introduction

The conservation of aquatic species is integral to the maintenance of viable plant and animal populations and biological diversity. National Forest System lands administered by the Forest Service in the Blue Mountains have long served an important role in supporting a variety of aquatic species that are critical to the needs and values of the human population. National Forest System lands in the Blue Mountains play an important role in supporting a variety of fish and other aquatic species critical to meeting the needs and values of people residing in the area. More than 30 native and 24 nonnative fish species occur in subbasins wholly or partly within the Blue Mountains national forests (Blue Mountains aquatic species list, project record). Some of these native species spend only a portion of their life cycles in National Forest System lands, others do not naturally occur within National Forest System lands due to absence of suitable habitat. Federal land management agencies and the state wildlife agencies share legal co-trustee responsibility for the protection and management of aquatic species. The Forest Service continues to work closely and cooperatively with both the Oregon Department of Fish and Wildlife (ODFW) and Washington Department of Fish and Wildlife (WDFW) for the conservation and management of wildlife resources, including habitat, within the Malheur, Umatilla, and Wallowa-Whitman National Forests. Such cooperation is important to meet the needs of a growing human

population that places increasing demands and competing values on resources, which ultimately impact the wildlife resource.

Managing ecosystems to sustain aquatic species depends on maintaining the appropriate mix of habitat quantity, quality, and distribution across the landscape. The categories and types of aquatic species within the Plan Area reflect the diversity of available habitat. Some species, such as Chinook salmon and steelhead, are steeped in local culture and tradition and have long been important to the local people and communities. However, other species have begun to receive greater recognition for the ecological values they offer as indicators of high-quality water (such as mussel species) or genetic and life history diversity contributions to sustainable populations of aquatic species (redband trout in the Columbia River Basin versus redband trout in the Oregon Closed Basins). Some of the species that occur within the Plan Area are migratory and/or wide ranging and can use several habitat types, while others are more sedentary and use only a single habitat or individual component within a habitat type (such as various species of spring-dependent snails).

The majority of effects to aquatic species result from the proposed management of other resources, such as wood fiber, motorized access, wildland fire, and livestock grazing. Although the life of a forest plan is 10 to 20 years, impacts to aquatic species are displayed on a decadal basis out to 20 years to clearly depict the trajectory for the habitat risks and restoration benefits analyzed for each alternative. Different levels of management are proposed for each of the alternatives, and each is described in detail in Chapter 2 and Appendix A. Unless otherwise noted, the description of effects is only for National Forest System lands in the Blue Mountains (excluding Hells Canyon National Recreation Area), and therefore references to the Plan Area, analysis area, or national forest are to public lands administered by the Forest Service, unless specifically noted otherwise.

Regulatory Framework

The three principle laws relevant to wildlife management are the National Forest Management Act of 1976, the Endangered Species Act of 1973, and the Magnuson-Stevens Act for Pacific Salmon. Direction relative to aquatic species is as follows:

- The National Forest Management Act requires the Forest Service to manage fish and wildlife habitat to maintain viable populations of all native and desirable non-native vertebrate wildlife species and conserve all listed threatened or endangered species populations (36 CFR 219.19).
- The Endangered Species Act requires the Forest Service to manage for the recovery of threatened and endangered species and the ecosystems upon which they depend. Forests are required to consult with the U.S. Fish and Wildlife Service if a proposed activity may affect individuals or habitat of a federally listed non-anadromous species. The Forest Service is required to consult with National Marine Fisheries Service if a proposed activity may affect individuals or habitat of a federally listed anadromous species.
- The Magnuson-Stevens Act requires analysis of effects to essential fish habitat for all Pacific salmon species, including those not listed under other laws or policies, where so specified by the National Marine Fisheries Service. The essential fish habitat designation

was finalized on December 18, 2014,[1] after the Draft Environmental Impact Statement was completed.

- Under the Magnuson-Stevens Act, federal agencies are required to consult with the National Marine Fisheries Service when any activity proposed to be permitted, funded, or undertaken by a Federal agency may have adverse impacts on designated essential fish habitat for Pacific salmon species. The essential fish habitat regulations define an adverse effect as "any impact which reduces quality and/or quantity of essential fish habitat . . . [and] may include direct (e.g. contamination or physical disruption), indirect (e.g. loss of prey, reduction in species' fecundity), site-specific or habitat wide impacts, including individual, cumulative, or synergistic consequences of actions."
- Forest Service Manual direction provides additional guidance: identify and prescribe measures to prevent adverse modifications or destruction of critical habitat and other habitats essential for the conservation of endangered, threatened and proposed species (FSM 2670.31 (6)). The Forest Service Manual also directs the Regional Forester to identify sensitive species for each National Forest where species viability may be a concern (FSM 2670.32), and to evaluate the effects of alternatives on Forest Service sensitive species in the Plan Area as part of the environmental analysis and planning process.

To comply with the previously mentioned laws, regulations, and policy, the following categories of species were analyzed in the forest planning process:

- **Surrogate species** selected as an indicator of the welfare of other species using the same habitat and with similar habitat requirements. Population and habitat conditions assessed for comparison of effects of alternatives. Rather than evaluating the viability of each individual species within the Plan Area, a representative (surrogate species) was selected to represent a group of species. The surrogate species approach is a credible and scientifically rigorous method to assess ecosystem conditions that contribute to the viability of wildlife species.
- **Threatened and endangered species** listed or proposed for listing under the Endangered Species Act. The Forest Service is required to consult with the U.S. Fish and Wildlife Service when a proposed activity may affect individuals or habitat of a listed nonanadromous aquatic species. The Forest Service is required to consult with National Marine Fisheries Service when a proposed activity may affect individuals or habitat of a listed anadromous aquatic species.

  The Forest Service Manual (FSM 2670.31 (6)) direction provides additional guidance: identify and prescribe measures to prevent adverse modifications or destruction of critical habitat and other habitats essential for the conservation of endangered, threatened and proposed species.
- **Forest Service sensitive species** – The 2011 Regional Forester's Sensitive Species List identified species identified by the regional forester as sensitive, whose presence either is suspected or has been documented within the Plan Area.

  For simplicity, the term "sensitive species" throughout the rest of this analysis will apply only to Forest Service sensitive species on the Regional Forester's List. The term will not refer to other species considered sensitive by other organizations or entities. The Regional Forester reviews lists of species developed by other organizations that have identified

[1] See Federal Register 79 FR 75449

species with viability concerns at state scale up to global scale, and selects those with concerns for viability on national forests for inclusion on the Regional Forester's Sensitive Species List as either documented or suspected on individual national forests in the region, based on best available information. The Regional Forester's Sensitive Species List used for this analysis was distributed in 2011 for use by Forest Service biologists across the region.

- **Management Indicator Species** required under the 1982 Planning Rule. The Blue Mountains Forest Plan Revision process used management indicator species for the purpose of assessing the impacts of the alternatives on wildlife and fish populations as directed in the 1982 Planning Rule (CFR 219.19 (a)(1) and (2)). The no-action alternative (Alternative A, no change in current management) was evaluated in terms of the management indicator species listed in the 1990 Forest Plans. Some of those management indicator species were selected and analyzed for the plan revision alternatives. Effects of alternatives to management indicator species were conducted using surrogate species viability modeling.
- **Focal Species** – species required under the 2012 Planning Rule for monitoring purposes. Although this plan revision was developed under the 1982 Planning Rule, it is required that the plan include a monitoring strategy that addresses the status of focal species as directed in the 2012 Planning Rule (36 CFR 219.12 (c)(1)). All surrogate species used in this analysis for comparison of alternatives, are also designated as focal species for monitoring purposes under the proposed Plan revision.
- **Essential Fish Habitat for Pacific Salmon** – Forest management in the Plan Area must be analyzed for effects to Essential Fish Habitat for Chinook and/or Coho salmon in subbasins designated by National Marine Fisheries Service under the Magnuson-Stevens Act. Federal agencies must consult with National Marine Fisheries Service under the Magnuson-Stevens Act when the preferred alternative has potential for adverse effects to essential fish habitat for Pacific salmon species in the Plan Area.

Surrogate Species and their Relationship to other Categories of Species

Species subject to a required viability analysis fall into a variety of categories for analysis based on concerns for viability, and some fall into multiple categories. Viability for each threatened, endangered, sensitive, and management indicator species will be discussed by applicable category as required by law and Forest Service policy. Species viability analyses and analyses for essential fish habitat will be presented by category in the following order:

- surrogate species
- threatened and endangered species
- Forest Service sensitive species
- management indicator species
- Magnuson-Stevens Act species

To assess effects to viability of native and desirable nonnative aquatic vertebrate species within each of the national forests, a suite of aquatic surrogate species was selected to represent other aquatic species in National Forest System lands with similar distributions or habitat requirements. Surrogate aquatic species were selected from among management indicator species in the 1990 Forest Plans, as well as from federally threatened, endangered, proposed and candidate species and Forest Service sensitive species (those on the Pacific Northwest Regional Forester's Sensitive

species list as of 2011), or which qualified for consideration based on the presence of Essential Fish Habitat for Pacific salmon, including those which are not federally listed.

The process for selecting surrogate species followed direction and guidance provided by Pacific Northwest Region Planning, using a regional model originally developed by Reiss et al (2008), the Aquatic Sustainability Model, which was modified for use in the Blue Mountains Plan Area. The model as used in the Blue Mountains Plan Area is described in detail in the Watershed Function section earlier in this Final Environmental Impact Statement and in the Plan Area. Data and model inputs, calculations and results are available in the planning record various aspects of the results are summarized in the comparisons of alternatives here and in the Watershed Function effects section.

Each surrogate species consists of one or more regional subgroups of the species, termed variously as evolutionarily significant units (ESU), distinct population segments (DPS), or geographic management units (GMU). Some subgroups have been listed under the Endangered Species Act, others have not.

- "**Evolutionarily significant units**" is a term used by the National Marine Fisheries Service and refers to regional subgroups of the various Pacific salmon species.
- "**Distinct population segment**" is used by the National Marine Fisheries Service to refer to regional subgroups of summer steelhead, as well as by the Forest Service Sensitive species list to refer to certain regional subgroups of redband trout. The term is also used by the U.S. Fish and Wildlife Service to refer to regional subgroups of bull trout and redband trout, and is the term used in the Endangered Species Act to describe subunits of species that are eligible for listing, or to describe subgroups of species that could be delisted separately by meeting specific recovery objectives identified in a species recovery plan.
- "**Geographic management unit**" is a term used by a regional State, Federal, and private sector working group to refer to regional subgroups of redband trout to facilitate development of a species-wide, multi-state conservation strategy for redband trout.

Each of these terms will be used as relevant for purposes of category discussions and as required by law and regulation in the analyses for individual aquatic species that follow.

Spring Chinook salmon, steelhead, bull trout and redband trout, the selected surrogate species, in aggregate occupy the full extent of fish-bearing habitat in National Forest System lands in the Plan Area and are species for which the Forest Service has enough information to evaluate effects of management and whose habitat could be substantially affected by management of National Forest System lands. Projected effects of alternatives on viability of each surrogate species will represent projected effects to viability for other aquatic species represented by that particular surrogate species.

Some federally listed species and sensitive species are limited in their distributions to certain subbasins, as is essential fish habitat, even though chosen surrogate species may occupy a broader area. The subbasin-scale analyses for each surrogate species facilitate subsequent assessments for more geographically limited sensitive species. Individual threatened and endangered species and certain sensitive species are not uniformly distributed across the Plan Area, and analysis for each such species or species subgroup is limited to the subbasins where spawning and rearing habitat for the individual species or species subgroup is present. For those few sensitive species on the Regional Forester's list that are not well represented by one or more of the selected surrogate species, effects conclusions were based on factors relevant to the species.

Table 237. Surrogate species and other species analyzed for viability, which are documented (D) or suspected (S) within the Malheur National Forest (including the portion of Ochoco National Forest administered by the Malheur National Forest)

Species, ESU/DPS[1]	Scientific Name	Presence (D or S)	Surrogate/Focal Species[2] (Yes or No)	Federally Listed	Sensitive[3] (Yes or No)	Management Indicator[4] (Yes or No)	Magnuson-Stevens Act[5] (Yes or No)
Spring Chinook salmon, Middle Columbia River ESU	*Oncorhynchus tshawytscha*	D	Yes	No	No	No	No
Bull trout, Columbia River Basin DPS	*Salvelinus confluentus*	D	Yes	Yes (Threatened)	No	Yes	No
Steelhead, Middle Columbia River Basin DPS	*Oncorhynchus mykiss*	D	Yes	Yes (Threatened)	No	Yes	No
Redband trout, Interior Columbia River	*Oncorhynchus mykiss*	D	Yes	No	No	Yes	No
Redband trout, Great Basin/ Oregon Closed Basins GMU (Malheur Lakes populations)	*Oncorhynchus mykiss*	D	Yes	No	Yes (Oregon only)	Yes	No
Westslope cutthroat trout	*Oncorhynchus clarki lewisi*	D	No	No	Yes (Oregon only)	Yes	No
Harney Basin duskysnail	*Colligyrus depressa*	S	No	No	Yes (Oregon only)	No	No
Western ridged mussel	*Gonidea angulata*	D	No	No	Yes	No	No
Shortfaced lanx	*Fisherola nuttalli*	S	No	No	Yes	No	No
Columbia clubtail	*Gomphus lynnae*	S	No	No	Yes	No	No
Pacific lamprey[6]	*Entosphenus tridentatus*	D	No	No	No	No	No

1. ESU/DPS = Evolutionarily Significant Unit/Distinct Population Segment as defined by National Marine Fisheries Service or U.S. Fish and Wildlife Service.
2. The surrogate species selected for viability modeling were also identified as focal species for purposes of forest plan monitoring under the 2012 Planning rule.
3. Regional Forester's Sensitive Species List, Region 6, (2011).
4. Management Indicator species in the 1990 Forest Plans.
5. See Federal Register 79 FR 75449
6. Public interest species only.

Table 238. Surrogate species and other species analyzed for viability, which are documented (D) or suspected (S) within the Umatilla National Forest

Species, ESU/DPS[1]	Scientific Name	Presence (D or S)	Surrogate/Focal Species[2] (Yes or No)	Federally Listed	Sensitive[3] (Yes or No)	Management Indicator[4] (Yes or No)	Magnuson-Stevens Act[5] (Yes or No)
Spring Chinook salmon, Snake River ESU	*Oncorhynchus tshawytscha*	D	Yes	Yes (Threatened)	No	No	Yes
Spring Chinook salmon, Middle Columbia River ESU	*Oncorhynchus tshawytscha*	D	Yes	No	No	No	Yes
Fall Chinook salmon, Snake River ESU	*Oncorhynchus tshawytscha*	D	No	Yes (Threatened)	No	No	Yes
Bull trout, Columbia River Basin DPS	*Salvelinus confluentus*	D	Yes	Yes (Threatened)	No	Yes	No
Steelhead, Snake River Basin DPS	*Oncorhynchus mykiss*	D	Yes	Yes (Threatened)	No	No	No
Steelhead, Middle Columbia River Basin DPS	*Oncorhynchus mykiss*	D	Yes	Yes (Threatened)	No	Yes	No
Redband trout, Interior Columbia River Basin	*Oncorhynchus mykiss*	D	Yes	No	No	Yes	No
Westslope cutthroat trout	*Oncorhynchus clarki lewisi*	D	No	No	Yes (Oregon only)	No	No
Margined sculpin	*Cottus marginatus*	D	No	No	Yes (Washington only)	No	No
Western ridged mussel	*Gonidea angulata*	D	No	No	Yes	No	No
Shortfaced lanx	*Fisherola nuttalli*	S	No	No	Yes	No	No
Columbia clubtail	*Gomphus lynnae*	S	No	No	Yes	No	No
Pacific lamprey[6]	*Entosphenus tridentatus*	D	No	No	No	No	No

1. ESU/DPS = Evolutionarily Significant Unit/Distinct Population Segment as defined by National Marine Fisheries Service or U.S. Fish and Wildlife Service
2. The surrogate species that were selected for viability modeling were also identified as focal species for purposes of forest plan monitoring per the 2012 Planning Rule.
3. Regional Forester's Sensitive Species List, Region 6, (2011). The only redband populations identified as Forest Service Sensitive are the Malheur Lakes populations on the Malheur National Forest. An interagency 2010 rangewide redband conservation strategy addresses all interior Columbia Basin redband populations.
4. Management indicator species in the 1990 Forest Plans.
5. See Federal Register 79 FR 75449
6. Public interest species only.

Table 239. Surrogate species and other species analyzed for viability, which are documented (D) or suspected (S) within the Wallowa-Whitman National Forest

Species, ESU/DPS[1]	Scientific Name	Presence (D or S)	Surrogate/Focal Species[2] (Yes or No)	Federally Listed	Sensitive[3] (Yes or No)	Management Indicator[4] (Yes or No)	Magnuson-Stevens Act[5] (Yes or No)
Spring Chinook salmon, Snake River Basin ESU	*Oncorhynchus tshawytscha*	D	Yes	Yes (Threatened)	No	No	Yes
Spring Chinook salmon, Middle Columbia River ESU	*Oncorhynchus tshawytscha*	D	Yes	No	No	No	No
Fall Chinook salmon, Snake River ESU	*Oncorhynchus tshawytscha*	D	No	Yes (Threatened)	No	No	Yes
Sockeye salmon, Snake River Basin[6]	*Oncorhynchus nerka*	D	No	Yes (Endangered)	No	No	No
Bull trout, Columbia River Basin DPS	*Salvelinus confluentus*	D	Yes	Yes (Threatened)	No	Yes	No
Steelhead, Snake River Basin	*Oncorhynchus mykiss*	D	Yes	Yes (Threatened)	No	Yes	No
Steelhead, Middle Columbia River Basin DPS	*Oncorhynchus mykiss*	D	Yes	Yes (Threatened)	No	Yes	No
Redband trout, Interior Columbia River	*Oncorhynchus mykiss*	D	Yes	No	No	Yes	No
Westslope cutthroat trout	*Oncorhynchus clarki lewisi*	D	No	No	Yes	Yes	No
Resident (non-anadromous) trout[7]	*Salvelinus* sp. *and Oncorhynchus* sp.	D	Yes (redband and bull trout only)	Yes (bull trout only)	Yes (westslope cutthroat only)	Yes	No
Margined sculpin	*Cottus marginatus*	D	No	No	Yes	No	No
Western ridged mussel	*Gonidea angulata*	D	No	No	Yes	No	No
Shortfaced lanx	*Fisherola nuttalli*	S	No	No	Yes	No	No
Columbia clubtail	*Gomphus lynnae*	S	No	No	Yes	No	No
Columbia pebblesnail	*Fluminicola fuscus*	D	No	No	Yes	No	No
Pacific lamprey[8]	*Entosphenus tridentatus*	D	No	No	No	No	No

1. ESU/DPS = Evolutionarily Significant Unit/Distinct Population Segment as defined by National Marine Fisheries Service or U.S. Fish and Wildlife Service
2. The surrogate species selected for viability modeling were also identified as focal species for purposes of forest plan monitoring under the 2012 Planning Rule.
3. Regional Forester's Sensitive Species List, Region 6, (2011)
4. Management indicator species in the 1990 Forest Plans.
5. See Federal Register 79 FR 75449
6. Sockeye salmon are present in the Snake River/Hells Canyon National Recreation Area migratory corridor only, outside the Plan Area.
7. Resident *Oncorhynchus* species include redband trout, westslope cutthroat, hatchery rainbow trout. Resident *Salvelinus* species include bull trout and non-native invasive brook trout. Viability modeling was only done for redband trout and bull trout, which serve as surrogates for viability of the other resident trout species, native and desired non-native. The viability modeling done for the species selected as surrogate/focal species serves as indirect (surrogate) viability analysis for management indicator and sensitive species not used as surrogates and not proposed as focal species. Westslope cutthroat, hatchery rainbow and brook trout were not carried forward as management indicator species for plan revision alternatives for reasons discussed later in the section discussing management indicator species.
8. Public interest species only.

The affected environment and effects of alternatives relative to federally listed, sensitive and management indicator species or Essential Fish Habitat will be analyzed based on effects to relevant surrogate species or spatially discrete subgroup of a surrogate species as appropriate, and discussed in the "Threatened and Endangered Species," "Sensitive Species," "Management Indicator Species" and Magnuson-Stevens Act (Pacific Salmon Essential Fish Habitat) sections, which follow the effects analyses for surrogate species.

For each individual species evolutionarily significant unit, distinct population segment, or geographic management unit, the goal for viability is to provide habitat sufficient to support self-sustaining populations in National Forest System lands within inherent capabilities of the landscape. "A self-sustaining population is one that is sufficiently abundant and has appropriate population characteristics to provide for its persistence over many generations" and "surrogate species populations are sustainable when their habitat is in good ecological condition and when they have access to habitat and other populations" (Reiss et al. 2008). For those species not currently listed under the Endangered Species Act, the intent is to provide ecological conditions that would help keep the species from being listed.

Aquatic Species Diversity – Affected Environment

Surrogate and Focal Species

The affected environment for species diversity consists of all fish habitat and all populations of the species selected for analysis within the 25 subbasins associated with the Plan Area. Lands of other ownership within each subbasin were assessed for purposes of cumulative effects analysis for these populations since the populations occupy many land ownerships in these subbasins. The affected environment includes all fish-bearing habitats in National Forest System lands, irrespective of species. Unless otherwise noted, the description of effects is only for fish populations and fish habitat within National Forest System lands in the Blue Mountains national forests Plan Area (excluding Hells Canyon Natural Recreation Area). Therefore, references to the Plan Area, analysis area, or national forest are to public lands administered by the Forest Service, unless specifically noted otherwise.

The area managed under the Hells Canyon National Recreation Area Comprehensive Management Plan contributes to species diversity. Management direction under the Comprehensive Management Plan will remain unchanged by this plan revision. Species that may be affected by ongoing management in the Hells Canyon National Recreation Area, but which would not be affected by revisions to the Forest Plans, will not be analyzed here.

Management direction specific to the key watershed network (priority and other key watersheds in aggregate) contributes to the maintenance or restoration of viable populations and aquatic species diversity. For PACFISH and INFISH, the immediate purposes for establishing key and priority watersheds were to protect fish habitat and to initiate passive restoration through natural processes. The key watershed network represents more of the land base in some subbasins than others (see Table 240).

Table 240. Current distribution of key (PACFISH) and priority (INFISH) subwatersheds by subbasin for each National Forest

Subbasin	Subwatersheds Occupied by One or More Federally listed Species	PACFISH Key Subwatersheds	INFISH Priority Subwatersheds
Malheur			
Middle Fork John Day	29	29	0
Upper John Day	47	47	0
Upper Malheur	19	0	19
Silvies	0	0	20
Silver	0	0	14
North Fork John Day	4	4	0
Harney-Malheur	0	0	4
South Fork Crooked River-Beaver Creek	0	0	7
Totals	**137**	**80**	**64**
Umatilla			
Middle Fork John Day	1	1	0
North Fork John Day	84	84	0
Lower John Day	4	4	0
Willow-Columbia	2	2	0
Umatilla	15	15	0
Walla Walla	10	10	0
Tucannon	7	7	0
Asotin	6	6	0
Lower Grande Ronde	25	25	0
Upper Grande Ronde	9	9	0
Totals	**163**	**163**	**0**
Wallowa-Whitman			
Imnaha	29	29	0
Lower Grande Ronde	29	29	0
Upper Grande Ronde	50	50	0
Lower Snake-Asotin	1	1	0
North Fork John Day	7	7	0
Hells Canyon, Brownlee	32	20	12
Powder	30	0	30
Burnt	0	0	22
Wallowa	22	22	0
Totals	**172**	**132**	**64**

Examples of passive restoration in progress include changes in certain fish-habitat metrics being monitored in Umatilla and John Day subbasins on the Umatilla National Forest (Archer et al. 2009, 2016a) based on the PACFISH-INFISH Biological Opinion long-term effectiveness monitoring program. With respect to trend analyses for the Umatilla National Forest's portions of the North Fork John Day subbasin, a Umatilla National Forest interdisciplinary team of

specialists (USDA Forest Service 2015) noted that significant accumulations of large woody debris in stream channels are occurring, and noted that those accumulations over time will likely drive subsequent improvements in additional indicators of habitat quality for aquatic species in forest watersheds. They also recognized that not all streams have the same habitat capabilities and that PACFISH-INFISH riparian management objectives were never intended to function as long-term one-size-fits-all metrics that apply to all fish-bearing streams. Some subbasins have insufficient sampling sites or insufficient repeat sampling at established monitoring sites to detect trends at the subbasin scale as yet.

As research has increasingly shown since 1995, landscape scale natural processes create shifting subwatershed mosaics through time and space, and watersheds with varying riparian and aquatic habitat conditions. The rich variety of life histories and mobility among members of the salmon and trout family demonstrate that as a group they are adapted to these landscape-scale disturbance processes, including high-severity wildfire events in environments where they represent the inherent fire regime; that is, those events are within the historic range of frequencies, severities and spatial extent for the particular vegetation types affected (Rieman et al, 1997; Howell, 2006), particularly when unaffected habitat remains accessible, is well-connected to habitats exposed to the disturbance event, and individuals maintaining a migratory life-history are still present in the population in question (Rieman and McIntyre, 1993). Based on the need to incorporate information gained over the past 15 years, the existing regional aquatic conservation strategies were combined and updated to create a new Regional Aquatic and Riparian Conservation Strategy (USDA Forest Service 2008, updated 2016). A revised set of key subwatersheds for the Blue Mountains forest plan revision was created under the guidance of the Regional Strategy and the Regional Aquatic Sustainability Model. This revised set of key watersheds was selected from all subbasins within the Plan Area and includes a set of priority watersheds targeted for active restoration over the life of the Plan. The list of key watersheds was identified based on guidance in the Regional Strategy (USDA Forest Service 2008) and methods described in the Regional Aquatic Sustainability Model (USDA Forest Service 2008, as locally adapted for application in the Blue Mountains Plan Revision; see Watershed Function Methods section in Chapter 3 of this document). The selection was based on the assumption that an appropriate distribution of habitat conditions can be provided on National Forest System lands within this set of watersheds that, in the long term, will support viability for the four surrogate species and for the other aquatic species they represent on each national forest.

Population and habitat conditions in subwatersheds used for spawning and rearing by the selected surrogate species served as the basis for selection of a revised set of key watersheds for the plan revision alternatives. The conditions and trends for surrogate species in National Forest System lands are particularly influenced by management actions and natural processes within the watersheds they inhabit, as discussed in the both the 2008 and 2016 Regional ARCS.

Consistent with guidance provided by the 2008 Regional ARCS and the regional Aquatic Sustainability Model used for comparison of alternatives (Reiss et al. 2008), key watersheds selected for this Plan Revision are a network of watersheds identified to serve, or which have the potential to serve, as strongholds for important aquatic resources (surrogate species). The term “focal species,” which was used in the 2008 Regional ARCS, the 2014 Draft Environmental Impact Statement and in Reiss et al. (2008), predates the term as it was defined for the 2012 Planning Rule, is not used the same way in this analysis; it is synonymous with the term and intent for “surrogate species” as used in this updated Final Environmental Impact Statement. Key watersheds are areas crucial to threatened, endangered, or sensitive fish and aquatic species, and/or areas that provide high quality water important for maintenance of downstream

populations. The value of the selected key watersheds to surrogate species (spring Chinook salmon, steelhead, bull trout and redband trout) was identified through application of the Blue Mountains Plan Revision Sustainability Model for Aquatic Species, and validated through review by fisheries biologists located on the affected national forests (Gecy 2013a).

Guidance provided by both the 2008 and 2016 Regional Aquatic and Riparian Conservation Strategies indicates that management of these areas is intended to emphasize minimizing risk and maximizing restoration or retention of ecological health. This guidance was brought forward into all alternatives, which vary in their proposed management strategies, and emphasize risk-reduction and health of aquatic ecosystems through Plan Revision goals, objectives, standards, and guidelines for key watersheds for all alternatives. The alternatives were designed with that guidance in mind, which has been reflected in Alternatives B through F developed for the Draft Environmental Impact Statement as of 2014 and the two additional alternatives developed since 2014. The identification of a revised set of key subwatersheds (including priority subwatersheds for active restoration) was based on the assumption that an appropriate distribution of habitat conditions can be provided in National Forest System lands within this network of key subwatersheds that, in the long term, will contribute to sustaining viability for the various populations of the selected surrogate species and the sensitive, management indicator species and additional listed species they represent.

The purpose for selection of surrogate species was to select species that inhabit streams used by other species (such as margined sculpins, lamprey, and sensitive aquatic mollusks, as well as federally listed fall Chinook salmon), and that those selected surrogate species use habitat features also used by other federally listed species as well as margined sculpins and other sensitive species on the Regional Forester’s Sensitive Species List (2011) for which we have little information. This plan focuses on effects to habitats used by species serving as surrogates for other sensitive species and assumes that if those habitats are improving or being maintained in good condition, that the agency’s management is not contributing to loss of the species and is helping to maintain viable populations of all species that require those habitat features which are also used by the surrogate species.

Aquatic Species Viability – Affected Environment

Surrogate and Focal Species

The four aquatic surrogate and focal species selected for this Plan revision are spring Chinook salmon, bull trout, summer steelhead, and redband trout. **For purposes of diversity and viability analysis and comparison of alternatives, these four species will be referred to simply as surrogate species for the remainder of the analysis, as they only function as focal species for Monitoring Plan purposes under the 2012 Planning Rule.** These surrogate species are all native salmonid species and represent broader biotic communities within various subsectors of aquatic habitats: headwaters, small tributaries, large tributaries, and rivers within the Plan Area. The selected surrogate species fall into two primary behavioral groups. Anadromous species, salmon and steelhead, breed and spend part of their life in fresh water, then travel to the ocean to feed until maturity, returning to fresh water 1 or more years later, to breed. Freshwater species, bull trout and redband trout, may migrate long distances seasonally within fresh water habitats but they spend all their lives in fresh water and never migrate to and from ocean habitats. Each primary behavioral group is secondarily split between spring-spawners and fall-spawners.

Each of these four species reflects adaptation to long term, local ecological characteristics and processes within each subbasin. Although their habitats overlap in places, each species uses a different portion of the wide range of aquatic habitats in National Forest System lands, depending on their life stage and season of the year, their habitat requirements, and current habitat conditions both on and off-forest. Current conditions for these species and their habitats on National Forest System lands reflect natural processes and watershed characteristics, along with the effects of past and present land management activities and on the species within the larger river basin landscapes in which those National Forest System lands are embedded. The ongoing and future influences of long-term climate change in the Pacific Northwest on aquatic surrogate species are discussed later in this chapter.

Fine-grained differences in habitat patterns of use by each species are described later in this section. Spawning and rearing habitat for one or more of the selected surrogate species is present in each subbasin in which Plan Area lands are located. As a group, these four species are well distributed throughout the subbasins within each national forest, but the distribution for individual species or subgroups varies across each forest.

For purposes of this discussion, subbasin-scale populations are connected networks of smaller local populations of each surrogate species and are analyzed separately, subbasin by subbasin using the Aquatic Sustainability Model. Effects to each subbasin population are based on a subwatershed-scale habitat and population condition model for each species and are aggregated by species using a subbasin-scale application of the Blue Mountains aquatic species sustainability model developed by Gecy (2013a). Both models are derivations of a Regional Sustainability Model developed by Reiss et al. (2008). Any strong local populations of any of the surrogate species that remain within the Blue Mountains National Forests are located within subwatersheds currently characterized by very limited management activity and low road density. The majority of those subwatersheds were identified as key watersheds, per the analysis process applied through the Blue Mountains aquatic sustainability model.

Long-term viability of each surrogate species is partially dependent upon availability of sufficient high quality spawning and rearing habitats within subbasins through time, as well as reliant on population and habitat connectivity within and between subbasins. Within National Forest System lands, an assortment of seasonal or year-round barriers currently impacts population connectivity. These barriers include physical barriers, such as culverts in National Forest System roads, barriers created by high water temperatures or low seasonal flow, and/or water diversions within National Forest System lands for beneficial uses outside the stream channel. The extent to which particular types of barriers impact a particular surrogate species is subwatershed and subbasin specific. Similar barriers in lands downstream of the National Forests further impair population connectivity within and between subbasins for each species.

All four surrogate species within the Plan Area occur as multiple distinct population segments or as multiple evolutionarily significant units of the species. One or more distinct population segments or evolutionarily significant units of each surrogate species is present within each national forest. Distinct population segments and evolutionarily significant units are important spatially defined regional subgroups within each species. Because component populations of each species are generally described by both U.S. Fish and Wildlife Service and National Marine Fisheries Service at the subbasin scale, except where otherwise noted, current viability status for each distinct population segment and evolutionarily significant unit is described in this order: first for each population based on subbasin boundaries, then summarized for each distinct population segment or evolutionarily significant unit as they occur within each national forest, followed by a

summary for each species where more than one distinct population segment or evolutionarily significant unit of the species is present within a national forest.

Surrogate Species Descriptions

Spring Chinook Salmon

Spring Chinook salmon are able to access intermediate sized tributaries and spawn farther upstream than fall run Chinook salmon and can be found in medium sized river reaches and tributaries within and downstream of national forest boundaries. Their habitat somewhat overlaps with steelhead habitat at the upper end of their distribution and overlaps with fall Chinook salmon habitat in the lower reaches of large rivers at the lower end of their distribution.

Non-native spring Chinook salmon stocks are present in the Umatilla and Walla Walla subbasins, where the original stocks are extinct. Hatchery stocks and wild stocks comingle in the Snake River Basin in subbasins below Hells Canyon Dam that are still accessible to anadromous species. Selection of spring Chinook salmon as a surrogate species represents the habitat needs of other aquatic species inhabiting lower elevation medium and large sized rivers and larger tributaries within the Plan Area, in particular, large bodied anadromous species and fall spawners.

Native spring Chinook salmon within the Plan Area belong to two different evolutionarily significant units that occur in non-overlapping portions of the Plan Area: the Middle Columbia River spring Chinook salmon evolutionarily significant unit and the Snake River Basin spring Chinook salmon evolutionarily significant unit. Snake River Basin spring Chinook salmon are listed as threatened under the Endangered Species Act; Middle Columbia River spring Chinook salmon are not listed at this time. The Malheur National Forest provides habitat for populations within the Middle Columbia River spring Chinook salmon evolutionarily significant units only whereas the Umatilla and Wallowa-Whitman National Forests provide habitat for populations of both evolutionarily significant units.

Viability analyses for Middle Columbia River spring Chinook salmon in the John Day River Basin and reintroduced nonnative stocks in National Forest System lands in other Middle Columbia River subbasins associated with the Plan Area would serve as surrogates for current viability of other non-Endangered Species Act-listed fall- spawning anadromous species in National Forest System lands (see Table 241), such as reintroduced coho, which are found downstream of the boundary of the Umatilla National Forest in the Umatilla River subbasin. The Snake River Basin spring Chinook salmon evolutionarily significant unit will be analyzed separately from the Middle Columbia River spring Chinook salmon evolutionarily significant unit where they both occur in the same National Forest to facilitate subsequent Endangered Species Act determinations for effects specific to Snake River Basin spring Chinook salmon, which serve as a surrogate for effects to Snake River fall Chinook salmon in the Plan Area. Overall conclusions for spring Chinook salmon as a surrogate species will be drawn based on review of effects to each individual evolutionarily significant unit, for those forests where both evolutionarily significant units are present (the Umatilla and Wallowa-Whitman National Forests).

Bull Trout

Bull trout exist express a variety of freshwater life histories, migratory and headwater non-migratory, within the plan revision area. Migratory bull trout move between their natal streams and larger bodies of freshwater, such as lakes, reservoirs and mainstem rivers where they can grow much larger than the nonmigratory individuals that remain in small colder, high-elevation

headwaters as adults. The migratory life history is still present in most of the populations associated with Blue Mountains national forests, but some headwater non-migratory populations have been isolated and are very small due to historic land use impacts. Connectivity among such non-migratory populations is no longer provided by migratory individuals and these populations are at heightened risk of long-term extirpation.

Bull trout, like spring Chinook salmon, are fall spawners with eggs that overwinter in the gravels and fry that emerge from redds in late winter and early spring. Bull trout tend to fare best where aquatic habitats provide not only cold water, but also high habitat complexity associated with instream large wood. Bull trout serve as a surrogate species based on their ability to represent aquatic species with similar habitat preferences and life history characteristics. They represent species present in medium-sized, high-elevation tributaries to headwaters, fall spawners, migratory freshwater species, those species requiring year round high quality cold water and habitat complexity, and those species closely associated with streambeds. Bull trout are noted for their affinity for cold headwaters and high habitat complexity and are an indicator of high quality habitat. Bull trout serve to a degree as surrogates for brook lamprey and Pacific lamprey ammocoetes, in that they associate closely with the streambed, although they prefer different microsites within streambeds once emerged from spawning gravels, and serve as surrogates for sculpin, which also associate closely with the streambed, and whose distributions extend into cold, higher-elevation headwaters used as year-round bull trout habitat where other species are less common.

Steelhead

Steelhead spawn and rear in medium and small rivers, tributary streams, and upstream portions of mainstem rivers. In the Plan Area, steelhead belong to two distinct population segments that occur in non-overlapping areas: the Middle Columbia River steelhead distinct population segment and the Snake River Basin steelhead distinct population segment. The Malheur National Forest provides habitat only for Middle Columbia River steelhead populations whereas the Umatilla and Wallowa-Whitman National Forests provide habitat for populations of both the Middle Columbia River and Snake River Basin steelhead distinct population segments. Both distinct population segments are listed under the Endangered Species Act.

Steelhead represent a different range of needs both spatially and temporally than spring Chinook salmon, although both species need good quality spawning and rearing habitat, cool water, and sufficient flow in the migration corridors as well as in spawning and rearing reaches. Steelhead as a surrogate species represent larger- bodied spring- spawning anadromous species using cool mid- elevation large tributaries to headwaters, within accessible portions of the Middle Columbia River and Snake River Basins. They will serve as a surrogate species for Pacific lamprey, which are one of the other anadromous spring-spawning species using these watersheds, because we know little about the current habitat distribution of lamprey, though juveniles lamprey (ammocoetes) are still observed on occasion in the Middle Fork John Day subbasin (S. Namitz, pers. comm.) and adults are still observed in main upper tributaries in the North Fork John Day subbasin now and then and have been reintroduced in the Umatilla River subbasin by the Confederated Tribes of the Umatilla Indian Reservation. Effects to Pacific lamprey will be assessed based on effects to surrogates because although they were not a Regional Forester’s sensitive species as of 2011, they were mentioned in public comments on the Draft Environmental Impact Statement and are recognized as a public-interest species.

The U.S. Fish and Wildlife Service was petitioned to list Pacific lamprey as threatened or endangered in 2003. The U.S. Fish and Wildlife Service published their findings in 2004 in the Federal Register (69 FR 77158), and determined that based on the information provided, that listing is not warranted for Pacific lamprey. Concerns remain, and U.S. Fish and Wildlife Service produced a guidance document, Best Management Practices to minimize adverse effects to Pacific lamprey in 2010, which is in use in the Blue Mountains Plan Area as best available science (U.S. Fish and Wildlife Service 2010). They followed that effort by spearheading development of an interagency, multi-state Pacific Lamprey Conservation Initiative, which has three major aspects: (1) an assessment (Luzier et al, 2011), (2) a conservation agreement (U.S. Fish and Wildlife Service 2012) signed by 29 states, tribes, and county and state and local organizations (including the Regional Forester for the Pacific Northwest Region of the Forest Service), and (3) multiple regional implementation plans.[2] The assessment concluded that existing threats to the species include passage barriers, streamflow management, stream and floodplain degradation and reduced water quality, which are also recognized as threats to listed species in the Plan Area. The regional implementation plans applicable to the Blue Mountains Plan Revision Plan Area include the Mid-Columbia and Snake Regional Implementation Plans (Poirier 2017, Brostom et al 2017). This assortment of documents are known and used by Forest Service biologists and their partners as best available science to incorporate lamprey conservation planning into projects designed to help recover federally listed species. Steelhead habitat is widespread throughout the accessible Columbia Basin portions of each forest in the Blue Mountains Plan Area, which is why steelhead were chosen as a surrogate for adult members of species with for which we have much more limited information.

Redband Trout

Redband trout are considered present wherever steelhead are present in the interior Columbia River Basin, including portions of the Snake River Basin downstream of Hells Canyon Dam. The juvenile life stages of the two forms can be very difficult to differentiate where they co-occur, as they are the same species (*Oncorhynchus mykiss*), but express two different life histories, steelhead expressing ocean-going anadromy and redband trout expressing year-round freshwater residency. Redband trout are found throughout the Plan Area, including subbasins where steelhead have no access.

Redband habitat requirements are similar to those of steelhead juveniles in freshwater, as they are the same species. Redband trout occupy small and medium rivers and streams year round. They spawn and rear in medium and small rivers and tributaries and upstream portions of mainstem rivers from late winter into May. As small-bodied lifelong-resident spring spawners, redband trout represent a different range of needs both spatially and temporally than spring Chinook salmon or steelhead. They spawn at elevations lower than those used by bull trout and tolerate warmer temperatures in their spawning and rearing habitats than bull trout. They are representative of species that preferentially use the middle to upper portions of the water column, as opposed to the streambed affinities displayed by bull trout. Redband trout are analyzed as a surrogate species based on their ability to represent non-anadromous freshwater aquatic species with similar habitat preferences and life history characteristics, particularly spring spawners, those requiring year-round good quality water, species inhabiting large tributaries to very small headwaters at middle elevations, and species in watersheds where no other surrogate species are present.

[2] https://www.fws.gov/pacificlamprey/Documents/Pacific%20Lamprey%20Conservation%20Agreement.pdf

Brook lamprey are one of the other spring-spawning, nonanadromous, native, small-bodied species using these watersheds; however, we know little about their current habitat distribution. Redband trout habitat is widespread throughout the accessible portions of each forest in the Blue Mountains Plan Area, particularly within the Middle Columbia and Snake River Basins, which is why redband trout were chosen as a surrogate for non-anadromous spring-spawning brook lamprey, for Pacific lamprey which spend years in fresh water, for westslope cutthroat trout and for other sensitive species for which we have much more limited information.

Current Status of Surrogate and Focal Species

Habitat and species status for each surrogate/focal species, were evaluated subbasin by subbasin, using National Forest System stream inventory data, information from other sources including subbasin assessments, recovery plans and status reviews and were applied using protocols described in Reiss et al. (2008). For purposes of analysis, a surrogate species is considered to be viable within the capabilities of an individual national forest when spawning and rearing habitat for that species is considered to be in fair or good riparian-aquatic condition and the species has fair or good access to habitat and related populations of the species within and between national forest system lands in subbasins used by that species. Federally listed species by definition are not currently viable at the scale at which they were listed (ESU/DPS), but may have component populations that are currently viable, which are defined at subbasin-scale across land ownerships. All-lands population status and trends, along with riparian-aquatic habitat condition and connectivity in the Plan Area are all used to describe current conditions for each surrogate/focal species in Table 241 through Table 244 below, using best available scientific information.

Condition of spawning and rearing habitat in each Plan Area subbasin, was assessed for each surrogate species, using the following criteria: (1) an area-weighted average of riparian and aquatic habitat conditions in subwatersheds used by the species for spawning and rearing, (2) how well the spawning and rearing habitat is distributed for the species in each subbasin, and (3) the quantity and location of culverts impairing access and connectivity among spawning and rearing habitats for the species. Passage barrier inventories of culverts available for each national forest, were reviewed and professional judgement used to determine for each surrogate species, the extent to which habitat and population connectivity is impaired at road-stream crossings within national forest boundaries as well as by downstream dams within some subbasins,.

Current trends for riparian and aquatic habitats for each aquatic species were assessed in this analysis, using data from regional-scale effectiveness monitoring using protocols developed in response to requirements of biological opinions for the 1990 Forest Plans as amended by PACFISH and/or INFISH (Archer et al. 2009, Archer and Ojala 2016a, 2016b, 2016c).

This monitoring is done at a larger scale than the Plan Area, but includes all portions of the Plan Area. Implementation of PACFISH and INFISH in their respective areas was designed to forestall any further management-related habitat degradation and to allow for nearly natural rates of habitat recovery. Passive restoration of riparian and aquatic habitats through natural processes appears to be occurring within National Forest System lands based on recent monitoring-based habitat trend analyses (Archer et al. 2009). The “Watershed Function, Water Quality, and Water Uses” section of Chapter 3 discusses these effectiveness monitoring results in greater detail, which will not be repeated here. Instead, it will simply be noted that riparian and aquatic habitat conditions are currently trending upward at the scale of the Plan Area, following 15-plus years of management under the 1990 Forest Plans as amended by PACFISH and/or INFISH, based on these monitoring results.

The 2018 Blue Mountains ARCS provides an adaptive strategy to refine the aquatic habitat metrics used for Watershed Condition Framework evaluations in the Blue Mountains Plan Revision area. That process would enable refinements of desired conditions for various metrics at meaningful watershed scales. This 2018 Blue Mountains ARCS provision was developed after the 2008 Regional ARCS was incorporated into desired condition statements for aquatic habitat. The long-term effectiveness monitoring program that has been underway under the PACFISH-INFISH Biological Opinion for the past 16 years would continue, and would provide a basis for comparison with effectiveness of the revised plans for restoring watersheds, streams, riparian and fish habitats. Plan level monitoring using protocols developed originally to assess effectiveness of PACFISH and INFISH direction, will continue to be conducted, building ever more robust data sets enabling us to detect trends in individual habitat indicators at national forest, subbasin, watershed, and reach scales and the effects of Forest Plan implementation on those indicators.

Spring Chinook Salmon

Subbasin-scale habitat and population conditions in each national forest are summarized in Table 241 and accompanying narratives for each forest. The table identifies populations as either belonging to the Middle Columbia River or Snake River Basin evolutionarily significant units. Population boundaries are based on descriptions in the Snake River Basin salmon and steelhead Recovery Plan (NMFS 2016) and the Middle Columbia River Steelhead Recovery Plan (NMFS 2009). Evolutionarily significant unit distinctions are made here to simplify and reduce redundancy of effects analysis and discussion specific to threatened Snake River Basin spring Chinook salmon evolutionarily significant unit in the section on “Threatened and Endangered Species” that follows.

Malheur National Forest – The Malheur supports two populations in two subbasins (Table 241). Chinook salmon spawning and rearing habitat in National Forest System lands is in fair condition based on riparian-habitat condition ratings from the Sustainability Model, and fair to poor within-subbasin connectivity based on location of culverts at National Forest System road crossings relative to salmon distribution.

Aquatic and riparian habitat conditions across the national forest are generally improving or showing non-significant trends depending on the indicator, based on PACFISH-INFISH Biological Opinion trend monitoring (Archer and Ojala 2016a). This monitoring at integrator sites also helps to determine National Forest System riparian-aquatic habitat trends on National Forest System lands at subbasin scale. In the Middle Fork John Day and Upper John Day subbasins, the majority of indicators show no significant change, however anywhere from one to three indicators show significant improvement. PACFISH-INFISH Biological Opinion monitoring results indicate that spring Chinook salmon habitat within the Malheur National Forest is being maintained, is slowly improving through natural processes on National Forest System lands, and is supporting viable Middle Columbia River spring Chinook salmon populations.

Active watershed restoration is ongoing with partners in the Middle Fork John Day subbasin on National Forest System lands as a consequence of implementing focused regional and national whole-watershed restoration strategies over the past ten or more years. Fish passage impairments at National Forest System road crossings are being redressed along with other essential restoration needs in the Middle Fork John Day subbasin, which contains the majority of Middle Columbia River spring Chinook salmon spawning and rearing habitat within the forest.

Table 241. Affected environment for spring Chinook salmon within the Blue Mountains national forests

Subbasin	Population Name	Population Status and Trend (all lands)[1]	Evolutionarily Significant Unit	Spawning and Rearing Habitat Miles and Condition-Connectivity (NFS lands)[2]
Malheur				
Middle Fork John Day	Middle Fork John Day	Viable/unknown	MCR[3]	15 miles/fair-fair
Upper John Day	Upper John Day	Viable/unknown	MCR	1 miles/fair-poor
Umatilla				
North Fork John Day	North Fork John Day	Viable/unknown	MCR	60 miles/fair-good
Umatilla	Umatilla	Reintroduced (nonnative stock)/ unknown	Hatchery/nonnative	8 miles/fair-good
Walla Walla	Walla Walla	Reintroduced (nonnative stock)/ unknown	Hatchery/nonnative	14 miles/fair-good
Tucannon	Tucannon	Not viable/increasing	SRB[4]	6 miles/fair-good
Lower Grande Ronde	Wenaha	Not viable/increasing	SRB	40 miles/fair-good
Designated Critical Habitats	SRB ESU only	N/A	SRB	284 miles
Wallowa-Whitman				
North Fork John Day	North Fork John Day	Viable/unknown	MCR	12 miles/good-good
Upper Grande Ronde	Upper Grande Ronde	Not viable/increasing	SRB	5 miles/fair-fair
Upper Grande Ronde	Catherine Creek	Not viable/increasing	SRB	19 miles/fair-good
Wallowa	Lostine/Wallowa	Not viable/increasing	SRB	12 miles/fair-good
Wallowa	Minam	Not viable/increasing	SRB	46 miles/fair-good
Imnaha	Imnaha	Not viable/increasing	SRB	41 miles/fair-good
Designated Critical Habitats	SRB ESU only	N/A	SRB	1,377 miles

1. National Marine Fisheries Service status and trend conclusions (Ford et al. 2010; Ford et al. 2011, updated based on Northwest Fisheries Science Center Population Status updates (NWFSC 2015), and NMFS (2016a, 2016b).
2. NFS (National Forest System) habitat status based on Blue Mountains Sustainability Model riparian-aquatic spawning and rearing habitat "condition" ratings combined with NFS culvert-impaired habitat connectivity ratings relative to current species distribution in NFS lands.
3. MCR: Middle Columbia River ESU (evolutionarily significant unit).
4. SRB: Snake River Basin ESU.

Umatilla National Forest – The Umatilla National Forest provides habitat for multiple populations within each of the Middle Columbia River and Snake River Basin spring Chinook salmon evolutionarily significant units. Overall, spawning and rearing habitat for both evolutionarily significant units throughout National Forest System lands is in fair condition based on riparian-habitat condition ratings from the Sustainability Model and good within-basin connectivity based on location of culvert barriers at National Forest System road crossings relative to current salmon distribution (Table 241). The few culverts or other physical barriers within National Forest System lands that once inhibited instream movement of Middle Columbia River and Snake River Basin spring Chinook salmon have been progressively upgraded or removed over the past 10 years.

National Marine Fisheries Service's Biological Review Team determined that habitat risks were moderate in the Umatilla and Walla Walla subbasins across all lands, which is consistent with fair habitat conditions in National Forest System lands for these populations (Table 241). The North Fork John Day population is the only native population in the Middle Columbia portion of the Umatilla National Forest. The National Marine Fisheries Service considers this a viable population at the all-lands scale.

Snake River Basin spring Chinook salmon have very little spawning habitat in non-wilderness National Forest System lands, other than in the mainstem Grande Ronde River and in the Wenaha River tributary to the Grande Ronde River, which are both managed as Wild and Scenic Rivers. Biological Review Team assessments (USDC-NMFS 2008) concluded that Snake River Basin spring Chinook salmon populations in the Grande Ronde and Tucannon subbasins are high risk and not viable, despite very low to moderate habitat risks in these subbasins. The most recent status and trend assessments by the National Marine Fisheries Service (NWFSC 2015; NMFS 2016b) for Snake River Basin spring Chinook populations associated with the Umatilla National Forest indicate that their populations are increasing.

Based on PACFISH-INFISH Biological Opinion monitoring at integrator sites across the national forest, most riparian and aquatic habitat indicators are showing non-significant trends, with meaningful changes in three of ten indicators, going in either direction (Archer and Ojala 2016b). Their monitoring at integrator sites also helps to determine riparian-aquatic habitat trends on National Forest System lands at the subbasin scale. In the North Fork John Day subbasin, two of five indicators show significant change, going in either direction, while the others remain trendless. In the Umatilla subbasin, one indicator demonstrates measurable improvement and the other nine indicators display no significant trends. Monitoring results suggest that spring Chinook salmon spawning and rearing habitat within the Umatilla National Forest is being maintained and slowly recovering in some subbasins, and that uncertain habitat recovery through natural processes warrants continued monitoring in others, as well as effective implementation of protective habitat management strategies. Intensive habitat restoration actions in the Tucannon subbasin, previously completed or underway appear to be contributing to restoring viability for that population, though it remains at high risk.

Active restoration is ongoing with partners on National Forest System and adjacent lands in the North Fork John Day and Tucannon subbasins as a consequence of implementing focused regional and national whole-watershed restoration strategies over the past ten or more years. Additional habitat restoration on National Forest System lands is ongoing with partner support in the Umatilla subbasin. The geographic distribution of active restoration efforts ensures that those efforts benefit populations of both Middle Columbia River and Snake River Basin spring Chinook salmon.

Wallowa-Whitman National Forest – The Wallowa-Whitman National Forest provides habitat for multiple populations, one within the Middle Columbia River spring Chinook salmon evolutionarily significant unit and several within the Snake River Basin spring Chinook salmon evolutionarily significant unit. Overall, spawning and rearing habitat in National Forest System lands for Snake River Basin spring Chinook salmon is in fair condition with good within-subbasin connectivity, based on riparian-habitat condition ratings from the Sustainability Model, and location of culvert barriers at National Forest System road crossings relative to current salmon distributions (Table 241).

Spawning and rearing habitat for Middle Columbia River spring Chinook salmon in the Wallowa-Whitman National Forest is located in the headwaters of the North Fork John Day Basin. Most of their spawning and rearing habitat there is located in wilderness and/or a wild and scenic river corridor and is in good condition with good access. The Middle Columbia River spring Chinook salmon evolutionarily significant unit is considered viable at the all-lands scale. The most recent status and trend assessments by the National Marine Fisheries Service (NWFSC 2015; NMFS 2016b) for the Snake River Basin spring Chinook populations associated with the Wallowa-Whitman National Forest indicate that their populations are increasing.

Based on PACFISH-INFISH Biological Opinion monitoring at integrator sites across the national forest, most riparian and aquatic habitat indicators are showing non-significant changes, with meaningful changes in four indicators, going in either direction (Archer and Ojala 2016c). Their monitoring at integrator sites also helps to determine riparian-aquatic habitat condition trends on National Forest System lands at the subbasin-scale. Within the Imnaha subbasin, most indicators are trendless, although 2 of 10 indicators show significant improvement. In the Upper Grande Ronde subbasin, changes in most indicators remain non-significant, though 1 indicator of 10 revealed measurable deterioration. Monitoring results indicate that spring Chinook salmon spawning and rearing habitat within the Wallowa-Whitman National Forest is being maintained and slowly recovering in some subbasins and that uncertain habitat recovery through natural processes warrants continued monitoring in others as well as effective implementation of protective habitat management strategies. Habitat recovery continues to sustain viable Middle Columbia River spring Chinook salmon populations and is contributing to recovery of Snake River Basin spring Chinook salmon viability. Faster habitat recovery within National Forest System lands, along with additional recovery actions on other land ownerships, may be needed to ensure recovery of Snake River Basin spring Chinook populations continues.

Active restoration is ongoing with partners in the North Fork John Day subbasin on National Forest System lands as well as downstream, benefitting Middle Columbia Riverspring Chinook salmon, and is also ongoing in the Imnaha and Upper Grande Ronde subbasins, benefitting two populations of Snake River Basin spring Chinook salmon (J. Vacirca, pers. comm.).

Bull Trout

Subbasin-scale habitat and population conditions in each national forest are summarized in Table 242 and accompanying narratives for each national forest. Spawning and rearing habitats for bull trout in National Forest System lands are predominantly in fair condition. The species is well distributed among multiple subbasins in each national forest. Within-population connectivity ranges from poor to good, depending on the subbasin and forest. Populations are described at scales approximating subbasin boundaries, and follow population boundaries described in the Bull Trout Recovery Plan (USFWS 2015). Discussions specific to each national forest follow.

Table 242. Affected environment for Columbia River Basin bull trout within the Plan Area

Subbasin	Core Area (Population) Names	Population Status and Trend (all lands)[2]	Spawning and Rearing Habitat Miles/ Condition-Connectivity (NFS lands)[3]
Malheur			
Upper Malheur	Upper Malheur	unknown/unknown-declining	34 miles/fair-poor
Upper Malheur	North Fork Malheur	unknown/unknown-declining	42 miles/fair-poor
Upper John Day	Upper John Day	stronghold-0-50 adults/unknown	25 miles/fair-poor
Middle Fork John Day	Middle Fork John Day	50-250 adults/unknown-declining	19 miles/fair-poor
Designated Critical Habitats	All	not applicable	344 miles
Umatilla			
Asotin	Asotin	0-50 adults/unknown	8 miles/fair-good
Tucannon	Tucannon	50-250 adults/declining	27 miles/fair-good
Lower Grande Ronde[1] Upper Grande Ronde	Lookingglass-Wenaha	stronghold-250-1000 adults/ stable	68 miles/fair-fair
North Fork John Day	North Fork John Day	50-250 adults/unknown-declining	42 miles/fair-fair
Umatilla	Umatilla	50-250 adults/declining	11 miles/fair-good
Walla Walla[1]	Walla Walla	50--250 adults/declining	55 miles/fair-good
Walla Walla[1]	Touchet	stronghold-50-250 adults/declining	18 miles/fair-good
Designated Critical Habitats	All	not applicable	286 miles
Wallowa-Whitman			
Upper Grande	Upper Grande Ronde (Catherine and Indian creeks)	50-250 adults/unknown-declining	62 miles/fair-fair
Wallowa	Little Minam	stronghold-250-1,000 adults/stable	12 miles/fair-good
Wallowa	Wallowa/Minam	50-250 adults/stable	80 miles/fair-good
North Fork John Day	North Fork John Day	250-1,000 adults/unknown-declining	32 miles/fair-poor
Imnaha	Imnaha	stronghold-250-1,000 adults/stable	76 miles/fair-good
Brownlee[1]	Pine, Indian and Wildhorse Creeks	250-1,000 adults/severe decline	33 miles/fair-fair
Powder	Powder (excludes Eagle Creek)	250-1,000 adults/severe decline	21 miles/poor-poor
Designated Critical Habitats	All	not applicable	514 miles

1. The bull trout Recovery Plan (USFWS 2015) has revised the bull trout core areas in the Grande Ronde, Wallowa, Hells Canyon and Powder subbasins.
2. From USFWS (2006, maps B and D), and USFWS (2008, Figures 1 and 3), updated with newer population/trend information from bull trout Recovery Plan (USFWS 2015).
3. National Forest System habitat conditions status based on Blue Mountains Sustainability Model riparian-aquatic “habitat” condition ratings combined with habitat connectivity ratings based on number and locations of culvert barriers passage concerns on National Forest System lands relative to species distribution.

Malheur National Forest – The U.S. Fish and Wildlife Service has identified four populations of bull trout in three subbasins associated with the Malheur National Forest. Within these three subbasins, the majority of bull trout spawning and rearing habitat is located in National Forest System lands. Bull trout spawning and rearing habitat in National Forest System lands is in fair condition based on riparian-habitat condition ratings from the Sustainability Model, but provide poor within-subbasin connectivity, based on location of culverts at road crossings relative to current bull trout distribution (see Table 242).

The most recent status and trend assessments by U.S. Fish and Wildlife Service for these bull trout populations indicate that populations are in either declining or unknown trends (USFWS 2008, USFWS 2015). Two dams downstream of the forest create impassible barriers that isolate both populations in the Upper Malheur River subbasin from all other populations, though prior to the dams, they were likely a larger subbasin-scale population connected via the main Malheur River downstream of both dams.

Aquatic and riparian habitat conditions across the national forest are generally improving or showing nonsignificant trends depending on the indicator, based on PACFISH-INFISH Biological Opinion trend monitoring (Archer and Ojala 2016a). Their monitoring at integrator sites also helps to determine riparian-aquatic habitat trends on National Forest System lands at the subbasin scale. In the Middle Fork John Day and Upper John Day subbasins, the majority of indicators show no significant change, however from 1 to 3 indicators show significant improvement. Four of 10 indicators in the Upper Malheur subbasin are demonstrating significant improving trends, while changes in others remain non-significant.

PACFISH-INFISH Biological Opinion monitoring results indicate that bull trout habitat within the Malheur National Forest is being maintained, is slowly improving through natural processes on National Forest System lands and is contributing to recovering viability for these bull trout populations. Given that populations are either very small, declining or both however, faster habitat recovery within National Forest System lands including improved within-population connectivity to reduce genetic drift and increase the probability of recolonization following localized extinctions that may occur due to demographics and/or major disturbance events such as the high-severity School Fire in 2005 that killed the local bull trout population in the Cummings Creek subwatershed of the Tucannon subbasin on the Umatilla National Forest. Additional recovery actions on other land ownerships may also be needed to restore viability to these populations. The Bull Trout Recovery Plan recognizes that not all populations may be recoverable, and has developed goals and strategies for recovery that recognize this reality. The Blue Mountains Aquatic and Riparian Conservation Strategy has been finalized for the Preferred Alternative, through informal consultation with U.S. Fish and Wildlife Service and content from the Bull Trout Recovery Plan used as best available science for maintaining or restoring bull trout viability on the Malheur National Forest.

Active watershed restoration is ongoing with partners in the Middle Fork John Day subbasin on National Forest System lands as well as downstream, as a consequence of implementing focused regional and national whole-watershed restoration strategies over the past ten or more years. Fish passage impairments at National Forest System road crossings are being redressed incrementally, along with other essential restoration needs.

Umatilla National Forest – The forest supports seven populations distributed among seven subbasins (Table 242). Bull trout spawning and rearing habitat within the Umatilla National Forest is in fair condition based on riparian-habitat condition ratings from the Sustainability

Model, and fair to good within-subbasin connectivity based on location of culverts at National Forest System road crossings relative to current bull trout distribution. The most recent status and trend assessments by the U.S. Fish and Wildlife Service for these bull trout populations indicate that most populations are in either declining or unknown trends (USFWS 2008 2015). One population is predominantly located in wilderness, and is considered stable. The Walla Walla population appears to be declining since an earlier conservation assessment conducted in 2005 (USFWS 2006, 2008), despite being centered in a subbasin with limited Forest Service management activity. Between-population connectivity via lands outside the national forest downstream is variable, and is affected by factors including downstream dams, irrigation withdrawals and distance between confluences.

Based on PACFISH-INFISH Biological Opinion monitoring at integrator sites across the national forest, most riparian and aquatic habitat indicators are showing non-significant trends, with meaningful changes in three of ten indicators, going in either direction (Archer and Ojala 2016b). Their monitoring at integrator sites also helps to determine riparian-aquatic habitat trends on National Forest System lands at the subbasin scale. In the North Fork John Day subbasin, 2 of 5 indicators show significant change, going in either direction, while the others remain trendless. In the Umatilla subbasin, 1 indicator demonstrates measurable improvement and the other 9 indicators display no significant trends.

Monitoring results suggest that bull trout spawning and rearing habitat within the Umatilla National Forest is being maintained and slowly recovering in some subbasins, that uncertain habitat recovery through natural processes warrants continued monitoring in others as well as effective implementation of protective habitat management strategies. Given that populations are either very small, declining or both however, faster habitat recovery is likely needed within National Forest System lands including improved within-population connectivity to reduce genetic drift and increase the probability of recolonization following localized extinctions that may occur due to demographics and/or major disturbance events such as the high severity School Fire wildfire in 2005 that killed the local bull trout population in the Cummings Creek subwatershed of the Tucannon subbasin on the Umatilla National Forest. Additional recovery actions on other land ownerships may also be needed to restore viability to these populations. The Bull Trout Recovery Plan recognizes that not all populations may be recoverable, and has developed goals and strategies for recovery that recognize this reality. The Blue Mountains Aquatic and Riparian Conservation Strategy has been finalized for the preferred alternative through informal consultation with U.S. Fish and Wildlife Service and content from the Bull Trout Recovery Plan used as best available science for maintaining or restoring bull trout viability on the Umatilla National Forest.

Active restoration is ongoing with partners on National Forest System and adjacent lands in the North Fork John Day and Tucannon subbasins as a consequence of implementing focused regional and national whole-watershed restoration strategies over the past 10 or more years. Additional habitat restoration on National Forest System lands is ongoing with partner support in the Asotin and Umatilla subbasins. These restoration efforts are benefitting bull trout populations in those subbasins.

Wallowa-Whitman National Forest – The forest supports seven populations in seven subbasins (Table 242). Overall, spawning and rearing habitat in National Forest System lands for bull trout is in fair condition, with in-subbasin habitat connectivity ranging from good to poor, based on riparian-habitat condition ratings from the Sustainability Model and location of culvert barriers at National Forest System road crossings relative to current bull trout distributions. Powder River

subbasin habitat for bull trout is highly fragmented within the national forest due to legacy mining impacts as well as high numbers of barrier culverts at road stream crossings. Connectivity within and between subbasins, is heavily fragmented by irrigation diversions, dams and reservoirs downstream of National Forest System lands. The most recent status and trend assessments by the U.S. Fish and Wildlife Service for these bull trout populations indicate that most populations are stable, though even some larger populations are declining, particularly where downstream dams and reservoirs impact within-population connectivity as well as between-population connectivity (USFWS 2006, 2008, 2015).

Based on PACFISH-INFISH Biological Opinion monitoring at integrator sites across the national forest, most riparian and aquatic habitat indicators are showing non-significant changes, with meaningful changes in four indicators, going in either direction (Archer and Ojala 2016c). Their monitoring at integrator sites also helps to determine riparian-aquatic habitat condition trends on National Forest System lands at the subbasin scale. Within the Imnaha subbasin, most indicators are trendless, although 2 of 10 indicators show significant improvement. In the Upper Grande Ronde subbasin, changes in most indicators remain non-significant, though 1 indicator of 10 revealed measurable deterioration. Monitoring results indicate that bull trout spawning and rearing habitat within the Wallowa-Whitman National Forest is being maintained and slowly recovering in some subbasins and that uncertain habitat recovery through natural processes warrants continued monitoring in others as well as effective implementation of protective habitat management strategies. Faster habitat recovery within National Forest System lands may be needed to ensure that stable bull trout populations remain stable and that habitat for other populations recovers at a rate that helps stabilize and recover declining populations. The 2018 Blue Mountains ARCS has been finalized for the preferred alternative through informal consultation with U.S. Fish and Wildlife Service and content from the Bull Trout Recovery Plan used as best available science for maintaining or restoring bull trout viability on the Wallowa-Whitman National Forest.

Active restoration is ongoing with partners in the North Fork John Day subbasin on National Forest System lands as well as downstream private lands, benefitting bull trout. Active restoration is also ongoing in the Imnaha and Upper Grande Ronde subbasins, benefitting two other bull trout populations (J. Vacirca, pers. comm.).

Steelhead

Subbasin-scale habitat and population conditions in each national forest are summarized in Table 243 with accompanying narratives for each forest. The table identifies populations as either belonging to the Middle Columbia River or Snake River Basin distinct population segments. Only the native anadromous (steelhead) forms of *O. mykiss* are listed, and effects to each listed steelhead distinct population segment must be analyzed separately under the Endangered Species Act. Population boundaries are based on descriptions in the Snake River Basin Salmon and Steelhead Recovery Plan (NMFS 2016) and the Middle Columbia Basin Steelhead Recovery Plan (NMFS 2009). Distinct population segment distinctions are made here to simplify and reduce redundancy of effects analysis and discussion specific to each distinct population segment in the section on “Threatened and Endangered Species” that follows.

Malheur National Forest – The forest supports four Middle Columbia River steelhead populations in three adjacent subbasins (Table 243). Steelhead spawning and rearing habitat in National Forest System lands is in fair to good condition based on riparian-habitat condition

ratings from the Sustainability Model, with fair to poor within-subbasin connectivity based on location of culverts at National Forest System road crossings relative to steelhead distribution.

Aquatic and riparian habitat conditions across the national forest are generally improving or showing non-significant trends depending on the indicator, based on PACFISH-INFISH Biological Opinion trend monitoring (Archer and Ojala 2016a). PACFISH-INFISH Biological Opinion monitoring at integrator sites also helps to determine riparian-aquatic habitat trends on National Forest System lands at subbasin scale. In the Middle Fork John Day and Upper John Day subbasins, the majority of indicators show no significant change; however, anywhere from 1 to 3 indicators show significant improvement. Integrator data for the North Fork John Day subbasin is insufficient to determine trend there at this point in time. PACFISH-INFISH Biological Opinion monitoring results in the first two subbasins indicate that steelhead habitat within the Malheur National Forest is being maintained, is slowly improving through natural processes on National Forest System lands and is contributing to recovery of steelhead populations. The North Fork John Day population is currently highly viable and growing, the Middle Fork and South Fork John Day populations are also viable and growing, while the Upper John Day population is meeting maintenance objectives at this point but still growing (NWFSC 2015, NMFS 2016a).

Active watershed restoration is ongoing with partners in the Middle Fork John Day subbasin on National Forest System lands, as a consequence of implementing focused regional and national whole-watershed restoration strategies over the past ten or more years. Fish passage impairments at National Forest System road crossings are being redressed incrementally, along with other essential restoration needs.

Umatilla National Forest – The Umatilla National Forest provides habitat for six steelhead populations within the Middle Columbia River distinct population segment and four populations within the Snake River Basin distinct population segment (Table 243). Spawning and rearing habitat in National Forest System lands in both basins is in fair to good condition based on riparian-habitat condition ratings from the Sustainability Model. Within-subbasin connectivity for Middle Columbia River steelhead is fair to good, based on location of culverts at National Forest System road crossings relative to Middle Columbia River steelhead distribution. Passage conditions on National Forest System lands are also fair to good throughout the Snake River Basin, based on location of culverts at road crossings relative to Snake River Basin steelhead distribution.

The North Fork and Middle Fork John Day subbasin populations in the Middle Columbia River steelhead distinct population segment are the only populations currently considered viable, although the Walla Walla, Umatilla and Lower John Day populations are considered stable and all Middle Columbia River steelhead populations are currently growing. Population status in the Snake River Basin varies between subbasins, but three of four populations are currently either viable or at least being maintained. Only the Tucannon population remains at high risk for being non-viable. Population trends for Snake River Basin steelhead populations are unknown for the most part, except for the Upper Grande Ronde population, which is believed to be growing.

Table 243. Affected environment for summer steelhead populations within the Plan Area

Subbasin	Population Name	Population Status and Trend (all lands)[1]	DPS[2,3]	Spawning and Rearing Habitat Miles/Condition-Connectivity (NFS lands)[4]
Malheur Middle Fork John Day	Middle Fork John Day	Viable/increasing	MCR	171 miles/good-poor
Upper John Day	Upper John Day	Maintained/increasing	MCR	97 miles/fair-fair
Upper John Day	South Fork John Day	Viable/ increasing	MCR	70 miles/fair-poor
North Fork John Day	North Fork John Day	Highly Viable/increasing	MCR	8 miles/fair-good
Designated critical habitats	MCR DPS only			410 miles
Umatilla North Fork John Day	North Fork John Day	Highly Viable/ increasing	MCR	365 miles/fair-fair
Middle Fork John Day	Middle Fork John Day	Viable/increasing	MCR	10 miles/fair-good
Lower John Day	Lower John Day	Maintained/increasing	MCR	8 miles/fair-good
Umatilla	Umatilla	Maintained/increasing	MCR	52 miles/fair-fair
Walla Walla	Walla Walla	Maintained/increasing	MCR	23 miles/good-good
Walla Walla	Touchet	Not viable/increasing	MCR	4 miles/fair-good
Tucannon	Tucannon	Not viable/Unknown	SRB	17 miles/fair-good
Asotin	Asotin	Maintained/unknown	SRB	8 miles/fair-good
Lower Grande Ronde	Lower Grande Ronde	Maintained/unknown	SRB	104 miles/fair-good
Upper Grande Ronde	Upper Grande Ronde	Viable/increasing	SRB	34 miles/good-fair
Designated critical habitats	SRB DPS only	not applicable	SRB	284 miles
Designated critical habitats	MCR DPS only	not applicable	MCR	647 miles
Wallowa-Whitman North Fork John Day	North Fork John Day	Highly Viable/declining	MCR	70 miles/good-fair
Asotin	Asotin	Not viable/unknown	SRB	3 miles/fair-good
Hells Canyon	Hells Canyon	Not viable/unknown	SRB	43 miles/fair-good
Lower Grande Ronde	Joseph	Highly viable/declining	SRB	181 miles/fair-fair
Upper Grande Ronde	Upper Grande Ronde	Viable/increasing	SRB	204 miles/good-fair
Wallowa	Wallowa	Maintained/unknown	SRB	86 miles/fair-good
Imnaha	Imnaha	Maintained/unknown	SRB	198 miles/good-good
Designated critical habitats	SRB DPS only	not applicable	SRB	1,377 miles
Designated critical habitats	MCR DPS only	not applicable	MCR	76 miles

1. NMFS status and trend conclusions (Ford et al. 2010; Ford et al. 2011, updated based on Northwest Fisheries Science Center Population Status updates (NWFSC 2015), and NMFS (2016a, 2016b). Status calls of "Maintained" are provisional, as they are based on limited or provisional data sets, "Stable" trend descriptions are based on tentative assessments of moderate risk to viability based on limited or provisional data sets.

2, 3. MCR: Middle Columbia River DPS; SRB: Snake River Basin Distinct Population Segment (DPS).

4. National Forest System habitat conditions status based on Blue Mountains Sustainability Model riparian-aquatic "habitat" condition ratings combined with habitat connectivity ratings associated with number and locations of culvert barriers passage concerns on National Forest System lands relative to spawning and rearing habitat distribution.

Based on PACFISH-INFISH Biological Opinion monitoring at integrator sites across the national forest, most riparian and aquatic habitat indicators are showing nonsignificant trends, with meaningful changes in three of ten indicators, going in either direction (Archer and Ojala 2016b). Their monitoring at integrator sites also helps to determine riparian-aquatic habitat trends on National Forest System lands at the subbasin scale. In the North Fork John Day subbasin, 2 of 5 indicators show significant change, going in either direction, while the others remain trendless. In the Umatilla subbasin, one indicator demonstrates measurable improvement and the other nine indicators display no significant trends. In the Snake River Basin, data for integrator sites in Snake River subbasins are insufficient to determine trend.

Monitoring results suggest that steelhead spawning and rearing habitat within the Umatilla National Forest is being maintained and slowly recovering in some subbasins, that uncertain habitat recovery through natural processes warrants continued monitoring in others as well as effective implementation of protective habitat management strategies. Monitoring results indicate that steelhead habitat conditions continue to contribute to restored viability of Middle Columbia River steelhead and may be contributing to recovery of viable Snake River Basin steelhead populations on National Forest System lands.

Active restoration is ongoing with partners on National Forest System and adjacent lands in the North Fork John Day and Tucannon subbasins as a consequence of implementing focused regional and national whole-watershed restoration strategies over the past 10 or more years. Additional habitat restoration on National Forest System lands is ongoing with partner support in the Umatilla subbasin. The geographic distribution of active restoration efforts ensures that restoration efforts benefit populations of both Middle Columbia River and Snake River Basin steelhead.

Wallowa-Whitman National Forest – The Wallowa-Whitman National Forest provides habitat for one Middle Columbia River steelhead population and six Snake River Basin steelhead populations in the Middle Columbia and Snake River basins respectively (Table 243). Spawning and rearing habitat in National Forest System lands in both river basins is in fair to good condition, and fair to good within-subbasin connectivity based on location of culverts at National Forest System road crossings relative to current steelhead distribution.

The most recent status and trend assessments by National Marine Fisheries Service (NWFSC 2015, NMFS 2016b) for Snake River Basin steelhead populations associated with the Wallowa-Whitman National Forest indicate that population status and trends vary by subbasin. National Forest System lands support two highly viable populations, one each in the Middle Columbia River and Snake River Basin steelhead distinct population segment. The Middle Columbia River steelhead population in the North Fork John Day subbasin is highly viable but declining in recent years despite good habitat conditions within Wallowa-Whitman National Forest System lands. Snake River Basin steelhead population trends are largely unknown, although the Upper Grande Ronde population is believed to be growing. The Joseph population in the Lower Grande Ronde subbasin, although highly viable, is also declining in recent years, similar to the trend in the North Fork John Day population.

Based on PACFISH-INFISH Biological Opinion monitoring at integrator sites across the national forest, most riparian and aquatic habitat indicators are showing non-significant changes, with meaningful changes in four indicators, going in either direction (Archer and Ojala 2016c). This monitoring at integrator sites also helps to determine riparian-aquatic habitat condition trends on National Forest System lands at the subbasin scale. Within the Imnaha subbasin, most indicators are trendless, although 2 of 10 indicators show significant improvement. In the Upper Grande

Ronde subbasin, changes in most indicators remain non-significant, though 1 indicator of 10 revealed measurable deterioration. Monitoring results indicate that steelhead spawning and rearing habitat within the Wallowa-Whitman National Forest is being maintained and slowly recovering in some subbasins and that uncertain habitat recovery through natural processes warrants continued monitoring in others as well as effective implementation of protective habitat management strategies. Faster habitat recovery within National Forest System lands may be needed to ensure that stable steelhead populations remain stable and that habitat for other populations recovers at a rate that helps stabilize and recover declining populations.

Active restoration is ongoing with partners in the North Fork John Day subbasin on National Forest System lands as well as downstream private lands, benefitting Middle Columbia River steelhead. Active restoration is also ongoing in the Imnaha and Upper Grande Ronde subbasins (J. Vacirca, pers. comm.). The geographic distribution of active restoration efforts ensures that those efforts benefit populations of both Middle Columbia River and Snake River Basin steelhead.

Redband Trout

Interagency conservation planning efforts have stratified redband populations in the Plan Area into spatially discrete conservation populations based on geographic clusters of subbasins (May et al. 2012). Redband trout populations in the Oregon Closed Basins constitute their own geographic management unit, long separated from populations and geographic management units in the interior Columbia River Basin. Table 244 provides an overview of redband trout populations within the Plan Area, their distribution among various geographically distinct geographic management units, and related habitat conditions in National Forest System lands across the Blue Mountains national forests. Discussions specific to each national forest follow.

Redband trout populations will be identified by geographic management unit for the remainder of this surrogate species analysis for redband, with three exceptions: (1) when referencing the Regional Forester’s Sensitive Species described as the Malheur Lakes distinct population segment (aka Oregon Closed Basins geographic management unit) for purposes of sensitive species analysis, based on the Regional Foresters list of sensitive species as of 2011; or, (2) when used by the U.S. Fish and Wildlife Service (2009) to refer to the Great Basin distinct population segment (Oregon Closed Basins geographic management unit); and (3) when discussing findings in Kostow (2003).

Malheur National Forest – National Forest System lands supports populations in seven subbasins, and are well distributed among four geographic management units (see Table 244). The John Day geographic management unit is the only one where steelhead is present, and the only one associated with the national forest, that is not currently targeted specifically for interagency redband conservation efforts (May et al. 2012). The Oregon Closed Basins geographic management unit, otherwise known as the Great Basin distinct population segment by U.S. Fish and Wildlife Service, is still considered viable by that agency (USFWS 2009), but the populations are believed to be declining. Redband trout of the Upper Malheur subbasin, though separated from other populations within the Middle Snake-Boise geographic management unit by impassible dams, are considered viable. They are supported within National Forest System lands by the amount of good-quality habitat available in wilderness and wild and scenic river management areas, despite poor within-basin connectivity due to location and quantity. Spawning and rearing habitat for redband trout in National Forest System lands is predominantly in good to fair condition, based on riparian-habitat condition ratings from the Sustainability Model, with good to poor within-subbasin connectivity based on location of culverts at National Forest System road crossings relative to redband trout distribution.

Table 244. Affected environment for redband trout populations within National Forest System lands in the Plan Area

Subbasin	Population Name	Population Status and Trend (all lands)[1,2]	Geographic Management Unit[3]	Spawning and Rearing Habitat Miles/ Condition-Connectivity (NFS lands)[4]
Malheur				
Upper Malheur	Malheur	Viable/unknown	MS-B[1]	142 miles/good-poor
Upper John Day	Upper John Day	Viable/unknown	JD[2]	144 miles/good-poor
Middle Fork John Day	Middle Fork John Day	Viable/unknown	JD	270 miles/good-poor
North Fork John Day	North Fork John Day	Viable/unknown	JD	15 miles/fair-good
Silvies	Malheur Lakes	Viable/declining	Oregon Closed Basins	104 miles/good-poor
Silver	Malheur Lakes	Viable/declining	Oregon Closed Basins	70 miles/fair-fair
Harney-Malheur Lakes	Malheur Lakes	Viable/declining	Oregon Closed Basins	5 miles/poor-poor
Crooked River/SF Beaver Creek	South Fork Beaver Creek	Viable/unknown	Deschutes	19/fair-good
Total Miles Habitat	All		All	769 miles
Umatilla				
Tucannon	Tucannon	Viable/unknown	LS[3]	88 miles/fair-good
Asotin	Asotin	Viable/unknown	LS	47 miles/fair-good
Lower Grande Ronde	Wenaha	Viable/unknown	LS	132 miles/good-good
Upper Grande Ronde	Upper Grande Ronde	Viable/unknown	LS	80 miles/good-fair
North Fork John Day	North Fork John Day	Viable/unknown	JD	550 miles/good-fair
Lower John Day	Lower John Day	Viable/unknown	JD	11 miles/poor-good
Umatilla	Umatilla	Viable/unknown	MC[4]	52 miles/good-fair
Walla Walla	Walla Walla	Viable/unknown	MC	27 miles/fair-good
Willow	Willow	Viable/unknown	MC	8/fair-fair
Total Miles Habitat	All		All	995 miles
Wallowa-Whitman				
Asotin	Asotin	Viable/declining	LS	40 miles/fair-good
Hells Canyon	Hells Canyon	Viable/declining	LS	88 miles/fair-good
Lower Grande Ronde	Grande Ronde	Viable/declining	LS	181 miles/good-fair
Upper Grande Ronde	Upper Grande Ronde	Viable/declining	LS	35 miles/good-fair
Wallowa	Wallowa	Viable/declining	LS	43 miles/fair-good
Imnaha	Imnaha	Viable/declining	LS	82 miles/good-good
Brownlee	Brownlee	Viable/declining	MS-B	60 miles/fair-fair
Powder	Powder	Viable/declining	MS-P[5]	370 miles/fair-poor
Burnt	Burnt	Viable/declining	MS-P	146 miles/fair-poor
North Fork John Day	North Fork John Day	Viable/declining	JD	66 miles/good-fair
Total Miles habitat				1,111 miles

1. Thurow et al. 2007.
2. May et al. 2012.
3. MS-B/Middle Snake-Boise Geographic Management Unit (GMU); JD/John Day GMU; LS/Lower Snake GMU; MC/Middle Columbia GMU; MS-P/Middle Snake-Powder GMU.
4. National Forest System habitat conditions status based on Blue Mountains Sustainability Model riparian-aquatic "habitat" condition ratings combined with habitat connectivity ratings associated with number and locations of culvert barriers passage concerns on National Forest System lands relative to spawning and rearing habitat distribution.

Aquatic and riparian habitat conditions across the national forest are generally improving or showing non-significant trends depending on the indicator, based on PACFISH-INFISH Biological Opinion trend monitoring (Archer and Ojala 2016a). Their monitoring at integrator sites also helps to determine riparian-aquatic habitat trends on National Forest System lands at the subbasin scale. In the Middle Fork John Day, Upper John Day, Silvies, and Upper Malheur subbasins, the majority of indicators show no significant change, however anywhere from one to four indicators show significant improvement. Integrator data for the North Fork John Day subbasin is insufficient to determine trend there at this point in time.

PACFISH-INFISH Biological Opinion monitoring results in 4 of the 5 subbasins where trend can be determined, indicate that redband trout habitat within the Malheur National Forest is being maintained, is slowly improving through natural processes on National Forest System lands. Habitat on National Forest System lands support multiple viable populations in several ecologically distinctive hydrologic basins containing two subspecies of redband trout: Oregon Closed Basins, Middle Snake River, Deschutes, and John Day basins.

Active watershed restoration is ongoing with partners in the Middle Fork John Day subbasin on National Forest System lands, as a consequence of implementing focused regional and national whole-watershed restoration strategies over the past ten or more years. Fish passage impairments at National Forest System road crossings are being redressed incrementally, along with other essential restoration needs.

Umatilla National Forest – The Umatilla National Forest provides habitat for several redband trout distributed among portions of the John Day, Middle Columbia, and Lower Snake geographic management units. Spawning and rearing habitat in National Forest System lands is in good-to-fair condition based on riparian-habitat condition ratings from the Sustainability Model, with the exception of the Lower John Day subbasin, where habitat is naturally limited. Within-subbasin connectivity is fair to good in the John Day and Mid-Columbia geographic management units, based on location of culverts at National Forest System road crossings relative to redband trout distribution. Passage conditions on National Forest System lands are also fair to good throughout the Snake River Basin, based on location of culverts at road crossings relative to redband trout distribution in the Lower Snake geographic management unit (Table 244). Redband populations are presumed viable, particularly since steelhead populations are growing in many of these subbasins. Nonetheless, redband trout population trends are currently unknown due to inability to distinguish redband trout from juvenile steelhead, large areas of spatial overlap in distribution of the two life histories, an intra-species breeding potential, and life history flexibility within the species.

Based on PACFISH-INFISH Biological Opinion monitoring at integrator sites across the forest, most riparian and aquatic habitat indicators are showing non-significant trends, with meaningful changes in three of ten indicators, going in either direction (Archer and Ojala 2016b). Their monitoring at integrator sites also helps to determine riparian-aquatic habitat trends on National Forest System lands at the subbasin scale. In the North Fork John Day subbasin, 2 of 5 indicators show significant change, going in either direction, while the others remain trendless. In the Umatilla subbasin, one indicator demonstrates measurable improvement and the other nine indicators display no significant trends. In the Snake River Basin, data for integrator sites in Snake River subbasins are insufficient to determine trend. Habitat monitoring results suggest that redband trout spawning and rearing habitat within the Umatilla National Forest is being maintained and slowly recovering in some subbasins, that uncertain habitat recovery through natural processes warrants continued monitoring in others as well as effective implementation of

protective habitat management strategies. Monitoring results and growing populations of steelhead suggest that redband trout habitat continues to sustain viable populations of redband trout in multiple geographic management units on National Forest System lands.

Active restoration is ongoing with partners on National Forest System and adjacent lands in the North Fork John Day and Tucannon subbasins as a consequence of implementing focused regional and national whole-watershed restoration strategies over the past ten or more years. Additional habitat restoration on National Forest System lands is ongoing with partner support in the Umatilla subbasin. The geographic distribution of active restoration efforts ensures that restoration efforts benefit well-distributed populations of redband trout across multiple geographic management units on National Forest System lands.

Wallowa-Whitman National Forest – The Wallowa-Whitman National Forest provides habitat for redband trout in portions of four geographic management units (Table 244). Spawning and rearing habitat in National Forest System lands is in fair to good condition, with fair to good within-subbasin connectivity based on location of culverts at National Forest System road crossings relative to current redband trout distribution.

In subbasins with lands in the Hells Canyon National Recreation Area, management direction is highly protective of fish habitat for redband populations belonging to the Lower Snake, Middle Snake-Powder, and Middle Snake-Boise geographic management units. The Imnaha subbasin provides high-elevation spawning and rearing habitat that is reasonably well connected within the subbasin. The majority of redband spawning and rearing habitat in the Imnaha subbasin is located within the national recreation area and/or within wilderness. Management direction within the national recreation area helps to support viable populations of redband trout within three of the four geographic management units represented by populations on the national forest, and contributes to the improving habitat trends that are becoming evident at the broader scale (Archer and Ojala 2016c). Redband populations are presumed viable, particularly since steelhead populations are growing in many of these subbasins. Nonetheless, redband trout population trends are currently unknown due to inability to distinguish redband trout from juvenile steelhead, large areas of spatial overlap in distribution of the two life histories, an intra-species breeding potential, and life history flexibility within the species.

Based on PACFISH-INFISH Biological Opinion monitoring at integrator sites across the national forest, most riparian and aquatic habitat indicators are showing non-significant changes, with meaningful changes in four indicators, going in either direction (Archer and Ojala 2016c). Their monitoring at integrator sites also helps to determine riparian-aquatic habitat condition trends on National Forest System lands at subbasin-scale. Within the Imnaha subbasin, most indicators are trendless, although 2 of 10 indicators show significant improvement. In the Upper Grande Ronde subbasin, changes in most indicators remain non-significant, though 1 indicator of 10 revealed measurable deterioration. Changes in Powder River subbasin are mostly non-significant, though two of ten indicators show substantial improvement. Most indicators show non-significant trends in the Burnt River subbasin, with meaningful deterioration in one indicator. Monitoring results and growing populations of steelhead indicate that redband trout spawning and rearing habitat within the Wallowa-Whitman National Forest is being maintained and slowly recovering in some subbasins and also that uncertain habitat recovery through natural processes warrants continued monitoring in other subbasins, along with effective implementation of protective habitat management strategies. Faster habitat recovery within National Forest System lands may be needed to ensure that degraded habitat recovers at a rate that helps stabilize and recover populations isolated from steelhead above Hells Canyon dam.

Active restoration is ongoing with partners in the North Fork John Day subbasin on National Forest System lands as well as downstream private lands, benefitting Middle Columbia River steelhead. Active restoration is also ongoing in the Imnaha and Upper Grande Ronde subbasins (J. Vacirca, pers. comm.). The geographic distribution of active restoration efforts ensures that those efforts benefit populations of both Middle Columbia River and Snake River Basin steelhead.

Threatened and Endangered Species

Important population segments of individual species have been listed separately as evolutionarily significant units or distinct population segments. This analysis therefore considers federally listed species at the distinct population segment or evolutionarily significant unit scale, together with their designated critical habitats. Table 237 through Table 239 display listed species present within each national forest in the Plan Area. Table 241 through Table 244 display the status of individual populations of each listed distinct population segment or evolutionarily significant unit associated with each of the national forests, the distribution of each species, the total amount of designated critical habitat within each national forest, and current habitat conditions within National Forest System lands. Status and trend information is based on the most current information available from recovery plans and status reviews by the responsible agencies. That information will not be repeated in this section.

Salmon

Sockeye Salmon (Snake River Basin Evolutionarily Significant Unit)

Snake River Basin sockeye salmon are only present within the Wallowa-Whitman National Forest. They use the mainstem Columbia and Snake Rivers as a migration corridor to reach their spawning areas in Idaho, outside the Plan Area. For purposes of this analysis, they are considered present only in the Hells Canyon National Recreation Area for the Wallowa-Whitman National Forest, which is managed under the Hells Canyon National Recreation Area Comprehensive Management Plan. No revisions to the comprehensive management plan are proposed. National Forest System lands within the Plan Area provide no spawning habitat and no early rearing habitat outside the mainstem Snake River. Management strategies and activities analyzed herein for the revised plans for the Blue Mountains national forests would have no effect on this species outside of effects previously considered and consulted for the comprehensive management plan and will not be discussed further in this analysis.

Fall Chinook Salmon (Snake River Basin Evolutionarily Significant Unit)

Snake River Basin fall Chinook salmon is listed separately as threatened under the Endangered Species Act and is considered a separate evolutionarily significant unit, the equivalent of a species under Endangered Species Act. Their spawning habitat is the Snake River and the lower ends of large tributaries in Wild and Scenic River management allocations in the Upper and Lower Grande Ronde River subbasins, in the Imnaha River in the Hells Canyon National Recreation Area downstream of the Plan Area, and well downstream of National Forest System lands in the Tucannon River subbasin. Viability of Snake River Basin fall Chinook salmon is primarily influenced by factors outside Forest Service control: mortality associated with upstream and downstream passage over multiple mainstem dams in the Snake and Columbia Rivers, cyclical ocean conditions, commercial, tribal and recreational harvest, and interbreeding with nonnative hatchery stock. Direct, indirect and cumulative effects to Snake River Basin fall Chinook salmon are based on effects to Snake River Basin spring Chinook salmon viability as a surrogate.

Spring Chinook Salmon (Snake River Basin Evolutionarily Significant Unit)

Snake River Basin spring Chinook salmon are found in the Tucannon, Grande Ronde, Wallowa, Imnaha, and Snake River/Hells Canyon subbasins within the Umatilla and Wallowa-Whitman National Forests. Characteristics of the species were discussed in the earlier section on surrogate species.

Steelhead

Two federally listed distinct population segments (Middle Columbia River and Snake River Basin) are located within the plan revision area.[3] The Middle Columbia River distinct population segment consists of steelhead populations in the John Day, Walla Walla, and Umatilla River subbasins. The Snake River Basin distinct population segment includes steelhead in the Tucannon, Asotin, Wallowa, Lower and Upper Grande Ronde, Imnaha, and Snake River/Hells Canyon subbasins. For purposes of Endangered Species Act listing, each distinct population segment is considered a separate species, with recovery goals for component populations at the subbasin scale or comparable scales; therefore, viability for steelhead is described by distinct population segment and by subbasin.

Middle Columbia River Steelhead Distinct Population Segment

Middle Columbia River steelhead and designated critical habitats are present in all three Blue Mountains National Forests. In the North Fork John Day subbasin, the Forest Service (Umatilla and Wallowa-Whitman National Forests) administers separate, but adjoining, portions of Middle Columbia River steelhead habitat in the subbasin.

Snake River Basin Steelhead Distinct Population Segment

Snake River Basin steelhead and designated critical habitats are present within two of the three Blue Mountains National Forests. The Malheur National Forest provides no habitat for Snake River Basin steelhead. The Umatilla National Forest provides the majority of habitat in National Forest System lands for some populations (such as the Tucannon subbasin). The entire Imnaha subbasin is within the Wallowa-Whitman National Forest. The Umatilla and Wallowa-Whitman National Forests provide approximately equal portions of other subbasins. In the lower Grande Ronde subbasin, the Umatilla National Forest includes lands draining the west side of the subbasin (Wenaha River watershed), and the Wallowa-Whitman National Forest includes lands draining the east side of the subbasin (Joseph Creek watershed), which support two different populations of Snake River Basin steelhead within the subbasin.

Bull Trout (Columbia River Basin Distinct Population Segment)

Columbia River Basin bull trout are found in all the Plan Area subbasins except for the Burnt River (NWPPC 2004a), the Oregon Closed Basins, and the South Fork Crooked River subbasin in the south end of the Plan Area. Bull trout core populations (Whitsell et al. 2004) have been generally identified at the subbasin level. Core populations in all of these subbasins are part of the Columbia River Basin distinct population segment, which is listed under the Endangered Species Act as threatened. For the remainder of this analysis, Columbia River Basin bull trout will be referred to simply as “bull trout.”

[3] http://www.nwr.noaa.gov/ESA-Salmon-Listings/Salmon-Populations/Steelhead/Index.cfm

Sensitive Species

The Regional Forester's Sensitive Species list identifies fish and aquatic invertebrate species for which viability is a concern as evidenced by significant current or predicted downward trends in population numbers or density, or significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution (Forest Service Manual 2670.5). These species have not yet reached a threshold for listing under the Endangered Species Act. Table 237 through Table 239 on pages 9 through 11 include sensitive aquatic species with documented or suspected presence in each of the Blue Mountains national forests, based on the 2011 Regional Forester's Sensitive Species list.

Aquatic invertebrate species listed as sensitive for one or more National Forests in the Blue Mountains plan revision area include the shortfaced lanx, Columbia pebblesnail, the pristine springsnail, the Harney Basin dusky snail, and the Western Ridged Mussel (Table 237 through Table 239).

Some of these species are found in fast flowing streams or rivers of various sizes, others are found in slow-moving, spring-fed waters. All are known or suspected to occur in high-quality aquatic habitats associated with good condition riparian areas. Small aquatic snails inhabiting springs and spring-fed channels have not been found in the Blue Mountains where springs have been previously developed (Frest and Johannes 1995), but have been found in undeveloped springs and spring runs with high water quality.

Riverine Mollusks

The **shortfaced lanx** is a freshwater limpet that attaches to large, clean, cobble-boulder substrate in large, fast, relatively warm rivers, such as the Snake River below Hells Canyon Dam.

The **western ridged mussel**, in its adult form, is a large, long-lived bivalve mollusk found in clean, gravel-cobble substrates in streams and rivers of the Blue Mountains, typically at higher elevations than other mussel varieties in the interior Columbia River Basin. Once they become local streambed residents, Western Ridged Mussels may live for decades so long as their habitat remains characterized by good water quality and low sediment conditions.

The **Columbia pebblesnail** is an aquatic snail found in large rivers of the Pacific Northwest, including the lower Snake River, the lower Grande Ronde River ten miles or more downstream of the town of Troy, Oregon, and in middle reaches of the Columbia River downstream of the Umatilla National Forest. In National Forest System lands, Columbia pebblesnails have only been documented in portions of the Snake and Salmon Rivers managed by the Wallowa-Whitman National Forest in the Hells Canyon National Recreation Area and are not suspected elsewhere within the Blue Mountains national forests.

Redband Trout, Great Basin Distinct Population Segment (aka Oregon Closed Basins Geographic Management Unit)

Basic species information and current conditions of population viability and habitat conditions for the Malheur Lakes portion of the Oregon Closed Basins geographic management unit of redband trout, are presented in the section on surrogate species and will not be repeated here. The redband trout in this geographic management unit inhabit several subbasins on the south end of the Malheur National Forest and comprise a portion of the Great Basin distinct population segment of the species. These are the only redband populations in the Plan Area that were identified as Forest Service Sensitive species on the 2011 Regional Forester's Sensitive Species List (Table 237 and Table 244).

Spring-dependent Snails

Species dependent upon microhabitats, such as high-quality springs and spring-fed riparian habitats, are not well represented by conditions and trends in habitats for the selected group of surrogate species. Their viability is much more closely related to conditions and trends in spring fed riparian areas. Conditions and trends for these limited habitats will be used as an indicator of viability for spring- dependent species not otherwise represented by aquatic vertebrate surrogate species or their habitats.

Based on surveys conducted within the Umatilla National Forest by Forest Service biologists, the **pristine springsnail**, a small aquatic snail, is found only in clear, cold, undeveloped springs and spring creeks within the Walla Walla and Umatilla River subbasins.

The **Harney Basin dusky snail**, is only known to be in one location in the Harney Basin (one of the Oregon Closed Basins), and has not yet been found in National Forest System lands. It is suspected to be present within the Malheur and Ochoco National Forests in the Oregon Closed Basins and Upper Malheur River subbasin portions of those forests, due to their presence in the Harney Basin. Little is known about this small, freshwater snail, other than that it has been found in habitat characterized as cold springs and associated spring channels.

Westslope Cutthroat Trout

Westslope cutthroat trout are a localized endemic of the Upper John Day subbasin within the Malheur National Forest. The species is considered an introduced species in headwaters of subbasins within the Umatilla and Wallowa-Whitman National Forests. Westslope cutthroat trout inhabit high elevation headwater tributaries and typically occur higher in the tributaries than do redband trout, to which they are closely related. Both redband trout and bull trout in the North Fork John Day and Upper John Day subbasins function as surrogate species surrogates for westslope cutthroat trout because pure cutthroat inhabit higher elevation tributaries than redband trout, and share cold headwater habitats with bull trout. Both cutthroat and redband trout are spring spawners and have hybridized in the area of elevational overlap between the pure populations of those two species in the North Fork John Day subbasin. All three species are non-anadromous species resident in freshwater throughout their life cycle. Viability of westslope cutthroat in the Umatilla and Malheur National Forests is uncertain, despite having fair to good habitat conditions in the North Fork and Upper John Day subbasins, considering the status of surrogate populations of steelhead and redband trout in those subbasins, the status of surrogate bull trout populations in those same subbasins, and hybridization with redband trout.

Margined Sculpin

Margined sculpin are a small fish requiring clean cool water and clean streambed substrate without much fine-sediment. They are only known to occur in three subbasins, all associated with the Umatilla National Forest: the Tucannon, Walla Walla, and Umatilla. Margined sculpin are known to be present in the mainstem Tucannon River, which is a medium-large river supporting both spring Chinook salmon and steelhead, and are also known to be present in at least one tributary to the Tucannon River that was also occupied by bull trout. Their small size and productivity relative to the amount and quality of available habitat available suggests sculpin populations are viable, however monitoring population status for this species is difficult because other sculpin species in the Blue Mountains are similar in appearance and accurate identification to the species level during field surveys is difficult for seasonal surveyors less familiar with the species. Sculpins that are found in these drainages are presumed to be margined sculpins, in the absence of expert identification to the species level. Sculpin are spring spawners, non-

anadromous, and associate strongly with the streambed, which they use for shelter, similar to juvenile bull trout, thus nonanadromous redband trout and bull trout both serve as surrogates for this species in those subbasins.

Management Indicator Species

The 1982 Planning Rule[4] requires that certain vertebrate and/or invertebrate species present in the area be identified and selected as management indicator species and the reasons for their selection stated:

> …the following categories shall be represented where appropriate: Endangered and threatened plant and animal species identified on State and Federal lists for the Plan Area; species with special habitat needs that may be influenced significantly by planned management programs; species commonly hunted fished or trapped; nongame species of special interest, and additional plant or animal species selected because their population changes are believed to indicate the effects of management activities on other species of selected major biological communities or on water quality.

Five species or groups of species from the trout and salmon family of fish (salmonids) were selected to serve as management indicator species in the 1990 plans because their habitat requirements encompassed a broad range of aquatic habitat conditions characteristic of the Blue Mountains national forests. In the 1990 Forest Plans, there was one general objective for management indicator species: to manage National Forest System lands to maintain viable populations of those selected species. However, the 1982 National Forest Management Act regulations (1982 Planning Rule) did not make a direct link between management indicator species and broad-scale species diversity. Population trends of management indicator species were not expected to represent trends in viability for other species.

The purpose of management indicator species monitoring was to evaluate the effectiveness of Forest Service management in maintaining habitat for the selected management indicator species; however, several of the management indicator species selected for the 1990 Forest Plans are significantly affected by human influences outside the management prerogative of the Forest Service. Indicators should be chosen for specific habitats identified as being at risk, where there is a high level of management actions anticipated, and where there is reasonable certainty that management indicator species population changes can be monitored and attributed to Forest Service activities (Hayward et al. 2004). It is this last criterion that the species previously selected and/or considered for continued use as management indicator species, fall farthest from meeting. Population changes in these species have proven difficult to tie specifically to management of National Forest System lands for reasons specific to each of the selected species, as discussed in this section.

The Malheur National Forest’s 1990 Forest Plan identified steelhead, redband trout, bull trout and westslope cutthroat trout as management indicator species, all native species. The Umatilla National Forest’s 1990 Forest Plan identified steelhead and redband trout as management indicator species. The Wallowa-Whitman National Forest’s 1990 Forest Plan identified steelhead and “resident trout” as management indicator species (which at the time included bull trout and redband trout, as well as introduced westslope cutthroat trout and non-native brook trout which were all considered desirable non-native species as game fish at the time), while the Ochoco National Forest’s 1990 Forest Plan identified “all trout” as management indicator species,

[4] 36 CFR219.19(a)(1)

however the portion of the Ochoco National Forest administered by the Malheur National Forest is located in the Oregon Closed Basins, where only redband trout are present.

None of the native aquatic management indicator species were Endangered Species Act-listed at the time the Blue Mountains forest plans were signed in 1990. Several steelhead and bull trout distinct population segments were subsequently federally listed as threatened between 1998 and 2010, along with their designated critical habitats, indicating a loss of viability at the distinct population segment or species scale. Reasons for those listings are provided in the various Federal Registers that announced the listings. No other 1990 aquatic management indicator species in the Plan Area have been listed as threatened or endangered since 2010. Redband trout and westslope cutthroat trout are the only remaining native aquatic management indicator species from the 1990 Forest Plans that are not currently listed under the Endangered Species Act. Brook trout are widely recognized now as an invasive species and a threat to bull trout with which they interbreed, to the detriment of the listed bull trout populations. Non-native brook trout were introduced as desirable game fish in times past and are present in scattered watersheds in all three national forests, but their current status is unknown. They are no longer considered a desirable nonnative species in the Plan Area, as they compete and hybridize with threatened bull trout, eventually decimating pure bull trout populations due to their comparatively higher rates of reproduction. All Forest Service fish habitat improvement projects currently are designed to minimize the risk of increasing brook trout populations in areas where they pose a threat to federally listed native bull trout. Westslope cutthroat trout distribution is patchy on all three National Forests. As already discussed, redband trout and bull trout serve as surrogates for westslope trout viability for this analysis, and have been designated as a regional Forest Service sensitive species by the Regional Forester.

Each of the 1990 Plans addressed monitoring for management indicator species populations at the forest scale in quite different ways. All three 1990 Forest Plans selected aquatic management indicator species based on their special habitat requirements. They were to serve as indicators of maintenance and quality of aquatic habitats. A data-intensive smolt habitat capability index model in regional use was the primary monitoring tool established in each forest plan. The model was designed to monitor managed habitat conditions for resident and anadromous management indicator species and evaluate those habitat capabilities relative to pristine habitat conditions. The specified habitat condition objectives were expected to potentially produce a corresponding number of smolts.

PACFISH and INFISH plan amendments established new metrics for fish habitat evaluation in 1995(riparian management objectives), and terms and conditions in Biological Opinions for federally listed Chinook salmon, steelhead and bull trout established new habitat monitoring requirements between 1995 and 1998 which resulted in the development of PACFISH-INFISH Biological Opinion Implementation and Effectiveness Monitoring programs which have been ongoing since 2001. This new monitoring protocol is not designed to forecast the number of smolts potentially produced based on habitat conditions and trends.

Population trends for federally listed anadromous species, steelhead and Chinook salmon, are now assessed by states and National Marine Fisheries Service at all-lands subbasin scales and estimated based on passage over various Columbia and Snake River hydropower dams, with population trends published in status reviews by National Marine Fisheries at 5-year intervals. U.S. Fish and Wildlife Service provides similar population trend estimates at all-lands subbasin scales for federally listed bull trout every 5 years, using information from a wide range of sources. Forest Service biologists use that status and trend information to refine project planning

and management for populations affected by management activities in the Plan Area and use professional judgement to develop estimates of population status within the forest, based on the broader scale population status and trends, and to assess the likelihood that on-forest habitat conditions and trends are contributing to the wellbeing of the species.

The Malheur National Forest 1990 Forest Plan specified use of the regional smolt habitat capability index model to tie habitat condition trends to population trends. Habitat surveys have continued, but population monitoring currently entails detecting changes in species distribution and population status, based on before-after distribution monitoring and presence-absence monitoring (S. Namitz, pers. comm.), without quantifying population trends for each management indicator species to habitat conditions through use of the smolt habitat capability index model which has been discontinued.

The Umatilla National Forest 1990 forest monitoring plan specified that management indicator species population trends would be monitored using several methods: 1) direct counts for steelhead via physical trapping and counting out-migrating steelhead smolts headed for the ocean, combined with smolt habitat capability modeling using habitat survey data, 2) steelhead redd surveys, 3) population trend data provided by state fish and wildlife agencies for steelhead and coordinated population trend monitoring between the Forest Service and state agencies. Stream surveys have continued over the years but funding has dropped and the quantity of stream surveys have dropped over the past 20 years. Species status and trend efforts have focused on refining distribution and habitat condition information, rather than quantifying population trends. Population trends for steelhead are now assessed by States and National Marine Fisheries Service at all-lands subbasin scales and estimated based on passage over various Columbia and Snake River hydropower dams, with population trends published in status reviews by National Marine Fisheries at 5-year intervals. Steelhead redd surveys are conducted on the Forest in limited locations, primarily on the Heppner ranger district, due to lack of staffing and funding, but smolt trapping has not been done in many years and efforts to apply the smolt habitat capability model has been discontinued for a variety of reasons, one reason being that field biologists could not distinguish between resident redband trout and juvenile steelhead during the low-flow season when fieldwork is typically done, after spring high flows have receded.

As stated in the Wallowa-Whitman glossary definition for the smolt habitat capability index, the index was designed to estimate the number of smolts that could be produced if habitat was in a specified condition. The Wallowa-Whitman 1990 monitoring plan also specified use of the smolt habitat capability index model to monitor population trends for anadromous and resident MIS. That monitoring protocol has fallen into disuse for similar reasons as the Umatilla.

The Ochoco National Forest 1989 Forest Plan specified monitoring all trout, including nonnative brook trout where they occurred, as well as native redband trout and steelhead populations. Only native redband trout are present in the portion of the Ochoco National Forest, portions of which (Silver and Crooked River-South Fork Beaver Creek subbasins), are administered by the Malheur National Forest and analyzed as part of the plan revision area.

Other aquatic species known present in the Plan Area were considered as candidates for management indicator species, but were not selected for a variety of reasons including lack of information on distribution or biology or current population conditions for the species. Most nongame species are believed to be less sensitive to effects of land management than are coldwater salmonids, particularly water temperatures and sediment levels in streambeds. Other

species are anadromous similar to salmon and steelhead and are affected by similar impacts to their populations in the migratory corridors downstream of National Forest System lands.

Other species prefer warmer and/or larger slower waters downstream of National Forest System lands, or may be species that would potentially benefit from land management impacts that would be considered detrimental to listed and sensitive coldwater species. Other species considered are strongly affected by management of lands downstream of National Forest System lands or are species for which there are no current concerns for viability and not expected to be detrimentally affected by forest management activities. Salmonid species are believed to be more sensitive to the types of land management activities likely to occur on National Forest System lands.

For reasons previously discussed, of the current management indicator species, only bull trout and redband trout were initially considered as possibilities for carrying forward as management indicator species in the new plan revisions. Redband trout are distributed in subbasins both inside and outside the range of steelhead, and are affected by management on both Federal and non-Federal lands in the subbasins where they are present. Attempts to evaluate effects of management based on population trends have not been successful on the Umatilla National Forest, which had specified smolt trapping and physically handling out-migrating steelhead smolts, but did not occur, due to funding and staffing challenges. Counts of spawning adults and redds are very difficult in the spring with high flows from snowmelt, while doing population assessments of juveniles during the summer low flow season proved unfeasible due to inability to distinguish between redband trout and juvenile steelhead at that time of year. Similar rationales apply for steelhead and westslope cutthroat trout, therefore habitat metrics were selected for monitoring effects of management on bull trout, redband, steelhead, and westslope cutthroat as management indicator species on the Malheur National Forest under the 1990 Plans. That habitat monitoring is ongoing on the Malheur National Forest through protocols established since 2001, for habitat monitoring required as a term and condition of the PACFISH and INFISH Biological Opinions.

As noted previously, upon reconsideration of options for management indicator species, which are required under the 1982 Planning Rule for purposes of comparing plan revision alternatives, together with types of monitoring acceptable for use with species chosen as focal species under the 2012 Planning Rule, redband trout, bull trout, steelhead and Chinook salmon were selected to carry forward as management indicator species for the proposed plan action alternatives. The utility of monitoring bull trout population trends for effects of management are limited. Bull trout are high-elevation species and use spawning and rearing habitats in upper watersheds with limited commercial timber management, infrequent high-intensity wildfires as a natural occurrence, limited forage production and suitability for livestock grazing. Most of their spawning and rearing habitat is located in areas predominantly allocated to wilderness and other low-roaded management area allocations. In addition, their migratory life history confounds efforts to detect population trends since a large part of their annual life cycle as adults is spent in larger rivers downstream of national forest lands during the winter and some populations are fragmented by dams below the national forest on both the Malheur and Wallowa-Whitman National Forests. For these reasons bull trout population trends were not considered to be a good indicator of management effects and why habitat monitoring is now the preferred method for monitoring their status as a focal species on national forest system lands, with status reviews from other agencies serving to monitor status and trends of each population for purposes of progress in species recovery across all land ownerships.

The biology and legal status of anadromous steelhead and spring Chinook salmon in the Middle Columbia and Snake River basins demonstrates that anadromous populations are heavily influenced by many factors outside and downstream of National Forest System lands. Steelhead and Chinook salmon both are highly migratory and spend a large portion of their lives in large rivers and oceans downstream of National Forest System lands. They are strongly affected by land and population management factors outside of National Forest System lands, all of which are beyond the management purview of the Forest Service.

Those factors include competition and interbreeding with hatchery stocks; tribal, recreational and commercial harvest; habitat conditions including water quality in the migratory river corridors and estuaries; and impacts of passing through multiple, mainstem hydropower dam operations during both emigration downriver to the ocean as subadults and as adults returning upriver to spawn in their natal streams. These population and evolutionarily significant units/distinct population segment level impacts are described in multiple documents, including the Middle Columbia River Steelhead Recovery Plan (NMFS 2009) and subbasin plans for the Middle Columbia River and Lower Snake River subbasins associated with the Plan Area (NWPCC 2004[5]).

Steelhead and redband trout juveniles are indistinguishable visually, and their spawning and rearing habitats overlap on National Forest System lands in year-round habitats. In addition, where they co-occur, offspring of female steelhead may mature into freshwater redband trout, and offspring of female redband trout may ultimately out-migrate to the ocean and return to National Forest System streams as adult steelhead (Carmichael et al. 2005). This uncertainty in adult development further limits reliability of viability assessments for steelhead and redband populations in National Forest System lands where steelhead and redband juveniles are both present year-round and cannot be distinguished from one another visually.

Conclusions regarding effects of forest management on populations of either steelhead or co-occurring redband trout as separate management indicator species from field surveys of spawning and rearing habitats on National Forest System lands become highly unreliable. Monitoring to detect population trends for the resident life history where steelhead are present is difficult to conduct without conducting expensive and extensive genetic testing of both juveniles and adults of both life histories throughout National Forest System lands, which has not been done for purposes of monitoring effects of forest management on either steelhead or redband populations as management indicator species.

Local populations (subwatershed scale) of interior redband trout across the Blue Mountains national forests are considered depressed, with low numbers, or of unknown status (Thurow et al. 2007); subwatershed-scale population assessment data for the selected surrogate species; project record). Redband populations within the current range of steelhead are also affected by habitat conditions outside the National Forests. They can be seasonally migratory within the subbasin-scale freshwater networks and may winter in larger streams in National Forest System lands and downstream in private and state lands, and are likely impacted by habitat fragmentation across ownerships. Redband trout are presumed present in all Columbia and Lower Snake River subbasins where steelhead are present.

For these reasons, changes in populations of either redband trout or steelhead at subbasin-scale do not necessarily reflect consequences of Forest Service management on either species/life history individually. The fact that redband and steelhead are known to interbreed may support population

[5] http://www.nwcouncil.org/fw/subbasinplanning/home/

viability for both life histories where they co-occur, but the extent to which this occurs or the extent to which each life history supports viability of the other, is unknown.

Redband trout populations in subbasins outside the current range of steelhead are heavily impacted by agricultural and urban development in migratory corridors downstream of National Forest System lands, and their habitats are naturally fragmented in the Oregon Closed Basins, and are fragmented by mainstem dams and water diversions in the Upper Malheur, Powder, and Burnt River subbasins downstream of National Forest System lands. The fact that redband trout populations are known to use habitats within National Forest System lands as well as habitats downstream of National Forest System lands, complicates monitoring efforts to detect effects of land management activities within National Forest System lands on these populations as a management indicator species, even in river systems where steelhead co-occurrence is not a confounding factor. Rieman et al. (2000) noted the extreme population fragmentation and related impacts of land management downstream of National Forest System lands in these subbasins, based on analyses conducted for the Interior Columbia Basin Ecosystem Management Project (ICBEMP).

Westslope cutthroat trout are a native species with limited presence in eastern Oregon and Washington, where they are on the outer limits of their natural distribution, which is centered in northern Idaho and western Montana. Westslope cutthroat are known to be present within the North Fork John Day and Upper John Day subbasins. Their population numbers within the Plan Area are unknown, but are likely similar to those of redband and bull trout populations in shared watersheds as their habitat requirements are similar.

Westslope cutthroat, although a true separate species, are closely related genetically to redband trout and steelhead and are known to experience hybridization zones where they overlap with redband trout and steelhead. Hybridization confounds efforts to detect effects of Forest Service management on westslope cutthroat trout as a standalone species. Similar problems may occur where brook trout have been introduced into bull trout streams.

Non-native brook trout are limited to a very few watersheds within the Plan Area and are not a management indicator species except where noted previously for the Ochoco and Wallowa-Whitman National Forests. Current population numbers are unknown, but local populations are suspected to be increasing wherever they occur. Non-native brook trout impact bull trout populations, in particular, through interbreeding which results in sterile hybrids and/or through relatively high reproductive rates, which leads to competitive displacement of bull trout that exhibit much lower reproductive rates. Brook trout also tend to out-compete westslope cutthroat trout for space and food supply where they co-occur. Their presence makes it much more difficult to detect correlations with land management for either bull trout or westslope cutthroat.

Although nonnative brook trout were included in the “resident trout” management indicator species group in the Wallowa-Whitman Forest Plan in 1990, brook trout are currently considered an undesirable nonnative introduced species in the Wallowa-Whitman National Forest due to their negative impacts on native bull trout and/or westslope cutthroat populations where brook trout co-occur with either of the other two species. Based on the hybridization and competition concerns for Threatened bull trout and Sensitive westslope cutthroat, brook trout are no longer considered a desirable nonnative species suitable for use as a management indicator species for any of the Blue Mountains national forests for purposes of monitoring population effects of land management on National Forest System lands.

Most bull trout populations in the Plan Area include both freshwater migratory and headwater year-round resident individuals. This mix of life histories is an adaptation to infrequent but catastrophic natural disturbances in their high-elevation habitats. The benefits of such disturbances are that they tend to deliver pulses of large wood and streambed material that provide new spawning gravels and increase habitat complexity, providing for resting places and cover to shelter them from predators and reduce energy demands imposed by fast streamflow. A fresh assortment of large streambed substrate provides spaces in the streambed where juveniles can hide from predators.

Most resident bull trout and spawning habitats are located in high-elevation habitats limited management is likely to occur, in that these areas are mostly allocated to wilderness, wild and scenic rivers corridors, municipal watersheds, backcountry nonmotorized use where timber harvest, livestock grazing and roaded access are limited. Natural disturbance processes in spawning areas are predominantly operating at natural frequencies, magnitudes and rates to which the species has adapted over centuries. Attempts to monitor bull trout populations are extremely difficult due to difficult access to remote headwater habitats, complex life histories and population networks interacting with large disturbance-prone landscapes to which the species is adapted. The remoteness of their headwater habitats, natural life history complexity of the species and the limited types of land uses in their habitats were some of the combined reasons why bull trout were not chosen for continuation as a management indicator species for the effects of forest management. Other reasons are summarized below.

Bull trout, redband trout, and steelhead populations in and downstream of National Forest System lands have become highly fragmented due to loss of access to migratory corridors and wintering habitats downstream of National Forest System lands through conditions created by impassible dams on main rivers, together with impacts of hybridization and competition with related, introduced species and nonnative hatchery stocks. Subbasin plans and recovery plans indicate that spawning and rearing habitats for federally listed distinct population segments and evolutionarily significant units in lands downstream of National Forest System lands are also degraded by past land use and/or accessibility within and among spawning and rearing habitat. The degree to which these species have been affected varies by subbasin and associated population. The cumulative impacts of historic and ongoing management in National Forest System and other lands are represented in the current habitat and population conditions and trends presented in Table 241 through Table 244.

Both anadromous and freshwater aquatic species considered here for use as management indicator species are affected by mainstem hydropower dam construction and operation, hatchery management, fishing regulation, (commercial and recreational fishing), mining, timber harvest, road building, water development and ongoing water uses in other ownerships downstream of National Forest System lands, as well as by ongoing and legacy habitat impacts of past management in National Forest System lands, particularly management in terms of mining, timber harvest, livestock grazing and road construction. Current population, habitat conditions, and trends both within and outside of National Forest System lands reflect those cumulative impacts to those species and their habitats, and are discussed in Federal Register listings for each threatened distinct population segment and evolutionarily significant units. They are also described in greater detail in Subbasin Plans for each Plan Area subbasin and in agency status reviews, recovery plans and draft recovery plans for listed evolutionarily significant units and distinct population segments.

Over the years since 1990, in consideration of the numerous Endangered Species Act-listings for populations that operate at scales that extend well beyond National Forest System lands, State and Federal biologists from many agencies have come to recognize that federal land management alone cannot ensure viability for sensitive species will not be lost due to factors outside national forest boundaries or beyond agency management authority, even if adequate habitat quality and quantity are available in National Forest System lands. Thus, the management indicator species concept and aquatic species selected as management indicator species have not served their intended management indicator species function well over the years. For the reasons discussed above, no aquatic management indicator species were chosen for any of the proposed Plan Revision alternatives in the Draft Environmental Impact Statement; however, as noted previously, a modified set of management indicator species will be used for analysis of action alternatives, as required under the 1982 Planning Rule. Spring Chinook salmon, steelhead, bull trout, and redband trout will be used as management indicator species for purposes of analyzing effects of action alternatives for all three National Forests.

Management Indicator Species Habitat

Repeatable riparian and stream habitat surveys designed for detecting habitat trends, as required by forest plan biological opinions for listed steelhead, spring Chinook salmon, and bull trout, have been ongoing throughout the Blue Mountains Plan Area since 2000. The survey areas include watersheds in which only non-listed redband trout are present. Those monitoring surveys are repeated on a five-year schedule, and enough repeat surveys have been completed during the past five years to allow for early indications of trend across the plan area for both riparian and aquatic conditions (Archer et al. 2009, Archer and Ojala 2016a, 2016b, 2016c). Early results display improving trends for a handful of indicators, non-significant changes in most other indicators, and detrimental changes in a few cases, as previously discussed in surrogate species discussions above. Improving trends in riparian vegetation and instream large wood inputs, where they have occurred, are expected to trigger follow-on responses in additional habitat indicators through natural processes (Day et al. 2015).

Aquatic Species Viability – Environmental Consequences

Species Viability – Overview

Viability analyses considered population conditions for each surrogate species and an assessment of the habitat necessary to sustain those populations. Spawning and rearing habitat and access to such habitat were considered the most crucial habitat elements provided by National Forest System lands and the most likely aspects of habitat to be affected by land management activities; therefore, analyses were based on effects to quality, quantity, distribution and access to spawning and rearing habitats. Conclusions regarding effects to viability were drawn at the subbasin (population) scale and by national forest for each surrogate species.

Management of National Forest System lands affects viability of aquatic species in two ways. The first way is the extent to which aquatic and riparian habitats and species are protected from detrimental effects of active land management, particularly from long-term detrimental effects of timber management, livestock grazing and/or road construction and motorized access as suitable uses. When riparian areas and aquatic habitats are protected from chronic impacts of these activities, they can typically recover without additional assistance from active restoration, but relatively slowly. Plan components including desired conditions, management area suitability for various land uses, and standards and guidelines thus promote ‘passive” restoration for purposes of

this analysis. Desired conditions apply across all plan revision alternatives in this analysis, while management area allocation acreages and configurations on the landscape, along with their associated suitable uses, vary across alternatives, as do certain standards and guidelines. Other standards and guidelines apply similarly across alternatives. Standards must be implemented as written. Guidelines must also achieve the intent of the measure, but allow for flexible ways to meet the intent. Alternatives E and F contain desired conditions for road density that do not apply to the other alternatives.

The Blue Mountains Aquatic Species Sustainability Model used in this analysis, follows the methods described in Reiss et al (2008), and assesses alternatives from the perspective of providing protection and reduction of risk of combined effects to fish and their habitats from forest management, livestock grazing and roaded access based land allocations and suitability for those uses. The model was designed to assess risk to viability for each of the individual surrogate species by alternative, based on the mix of land allocations and suitability for these uses, in each subbasin occupied by the species. Model calculations at subbasin scale describe relative risk that aquatic habitats on National Forest System lands would be exposed to habitat risks associated with those uses, for each individual surrogate species with spawning and rearing habitat on National Forest System lands in a subbasin, in the absence of additional protective plan components such as desired conditions, standards and guidelines and monitoring, which are designed to reduce those risks to aquatic habitats or even avoid them altogether, depending on the alternative. Protective measures are based on the presumption that passive restoration of aquatic habitats and species will occur through natural processes at near-natural rates in the absence of further degradation. Methods, assumptions and data used in the Sustainability Model to develop protection metrics are described in the Watershed section.

The second way management of forest system lands affects aquatic species viability is through active restoration of watershed functionality, which may require restoring upland watershed conditions as well as riparian and aquatic habitats. Quantitative objectives for active watershed, riparian and aquatic habitat restoration are one of the key emphases in the plan revision alternatives, as a way to accelerate achievement of desired conditions and meet ecological goals, though the degree to which such objectives would be accomplished varies by alternative. Methods, assumptions and data used in the Sustainability Model to estimate the number and types of watersheds likely to be improved under each alternative are described in the “Watershed Function, Water Quality, and Water Uses” section, along with projections as to number of watersheds improved through various methods and combinations of methods, in 10 and 20 years. Appendix A of this document compares various pertinent active restoration objectives under each action alternative. Objectives would be applied in priority watersheds and opportunistically in other watersheds. New priority watersheds would be selected for additional active restoration from among key watersheds, when all essential active restoration needs have been addressed in current priority watersheds, or when priorities change due to changed conditions. Decisions as to priorities for Watershed Condition Framework priority watershed restoration scheduling would remain at local forest administrator’s discretion.

Examples of active restoration that would serve to maintain or restore viability for aquatic species, take place in or near the stream channel, example, restoration of fish passage by removing or upgrading a culvert barrier at a road-stream crossing, or replanting riparian shrubs to restore stream shade to provide cooler water and improve streambank stability to reduce sediment inputs that clog spawning gravels. Such actions would contribute to improved viability of aquatic species relatively quickly. Other activities to restore watershed function and processes in priority watersheds would take place in the uplands, such as restoring stand structure and composition to

reflect and enable the return of nature fire frequencies and intensities in dry forest landscapes, and reducing sediment inputs and hydrologic connectivity between the road network, both in uplands and in the valley bottoms. Such actions would improve species viability indirectly and more slowly.

The greater the number of priority and other key watersheds holistically restored, the greater the benefits of the alternative to viability of aquatic species inhabiting those watersheds. The most immediate benefits are likely to come from restoration of riparian and aquatic habitats, including reduced hydrologic connections between roads and streams and improving riparian forest vegetation. Longer-term benefits are expected to accrue from restoration of uplands in the same watersheds. The full suite of priority watersheds on each forest would not be restored under any of the alternatives during the life of the Plan, or even necessarily within the first 20 years. The number of priority watersheds expected to be restored over the first 10 years varies by alternative.

Because of uncertainty as to which watersheds would be restored over the life of the plan, the extent to which any particular surrogate species will benefit from a given alternative cannot be known, as not all surrogate species are present in the same priority watersheds. What can be known, however, is that at least one surrogate species will benefit whenever a priority or other key watershed is improved. Table 245 displays subbasins contain priority watersheds that, when restored, are likely to provide benefits to a given species.

Because each of the four surrogate species is non-uniformly distributed within each forest, this section assesses how well the Plan alternatives would maintain distributions and provide sustainable habitat for each aquatic surrogate species in each forest. Basic plan protection metrics are based on land allocations and their suitable uses.

Assumptions for Species Viability

- PACFISH and INFISH were designed as conservation strategies to prevent further habitat degradation and initiate habitat restoration through natural processes. Protection scores calculated for Alternative A are accordingly assumed to represent a baseline of no degradation from existing condition on a species-by-species basis, for purposes of comparison of alternatives, except where noted in existing habitat trend discussions based on PACFISH-INFISH Biological Opinion monitoring indicators earlier.
- A further assumption for purposes of comparing alternatives, is that near-natural rates of recovery through natural processes are in progress to varying degrees on each forest, and that degradation is no longer occurring, as a baseline for comparison with plan revision alternatives and that Alternative A would continue those patterns, based on PACFISH-INFISH Biological Opinion trend monitoring reports for each forest (Archer and Ojala 2016a-c). Protection scores for plan revision alternatives are assumed to represent slightly faster or slower rates of recovery through natural processes, depending on the degree of difference from protection scores for Alternative A, and in consideration of modeling results for riparian-aquatic improvements in watershed conditions forestwide by alternative.
- Viability analyses for surrogate species or subgroups of surrogate species that represent effects to viability for other sensitive species or other species sharing their habitats with similar habitat requirements the habitats requirements and/or geographic distributions are similar.
- Multiple-scale analysis would be conducted to identify and prioritize active restoration needs for priority watersheds.

Table 245. Distribution of key subwatersheds (KWS) (priority subwatersheds in parenthesis) for all alternatives, including Alternatives E-Modified and E-Modified Departure, relative to surrogate species habitats within the Blue Mountains national forests

Subbasin	Bull Trout	Chinook salmon	Steelhead	Redband Trout[4]	Total KWS[1]	Current KWS[5] (Alternative A)
Malheur						
Middle Fork John Day	5 (5)	12 (12)	15 (15)[2]	15 (15)[2]	15 (15)	29 (15)[2]
Upper John Day	4 (0)	1 (0)	15 (0)	9 (0)	17 (0)	47 (0)
Upper Malheur	3(3)	NA	NA	11 (10)	15 (10)	19 (7)
Silvies	NA	NA	NA	10 (0)	10 (1)	0
Silver	NA	NA	NA	4 (4)	4 (4)	0 (4)
North Fork John Day	0	0	0	0	0	4 (0)
Harney-Malheur	NA	NA	NA	0	0	0
South Fork Crooked River-Beaver Creek	NA	NA	NA	0	0	0
Malheur National Forest Totals	18 (7)	13 (12)	30 (15)	49 (29)	59 (29)	99 (26)
Umatilla						
Middle Fork John Day	NA	NA	0	0	0	1 (0)
North Fork John Day	9 (2)[2]	9 (2)[2]	20 (8)[2]	20 (8)[2]	20 (11)	84 (12)[2]
Lower John Day	0	NA	0	0	0	4 (0)
Willow-Columbia	NA	NA	NA	0	0	2 (0)
Umatilla	4 (0)	4 (0)	6 (0)	6 (0)	6 (0)	15 (0)
Walla Walla	4 (0)	1 (0)	3 (0)	3 (0)	4 (0)	10 0)
Tucannon	4 (4)[2]	2 (2)	4 (4)[2]	4 (4)[2]	4 (4)	7 (4)[2]
Asotin	4 (0)	NA	4(0)	2 (0)	5 (0)	6 (0)
Lower Grande Ronde	12 (0)	8 (0)	12 (0)	12 (0)	12 (0)	25 (0)
Upper Grande Ronde	1(0)	1(0)	1 (0)	1 (0)	1 (0)	9 (0)
Umatilla National Forest Totals	38 (6)	25 (4)	49 (12)	49 (12)	38 (15)	163
Wallowa-Whitman						
Imnaha	9 (4)[1]	9 (4)[2]	9 (4)[2]	9 (4)[2]	9 (4)	27 (4)[2]
Lower Grande Ronde	5 (0)	0 (0)	5 (0)	5 (0)	12 (0)	23 (0)
Upper Grande Ronde	19 (13)[2]	9 (9)[2]	24 (13)[2]	24 (13)[2]	27 (16)	27 (15)[2]
Lower Snake-Asotin	0	0	0	0	0	1 (0)
North Fork John Day	5 (2) [2]	5 (2) [2]	6 (3) [2]	6 (3) [2]	6 (3)	10 (3)[2]
Brownlee (in the HCNRA)	5 (3)	NA	NA	6 (4)	7 (5)	7 (4)
Powder	3 (0)	NA	NA	4 (0)	6 (0)	7 (0)
Burnt	NA	NA	NA	4 (0)	11 (0)	0
Wallowa	16 (0)	12 (0)	13 (0)	13 (0)	18 (0)	16 (0)
Wallowa-Whitman National Forest Totals	66 (21)	44 (18)	81 (20)	65 (24)	96 (28)	112 (26) (Hells Canyon not included)

1. Includes priority (key) watersheds for active restoration as defined for plan revision alternatives. Subwatersheds with multiple species are only counted once for purposes of total KWS count. Totals do not represent sum of KWS for individual surrogate species.
2. Denotes one or more current Watershed Condition Framework priority watersheds benefit this species in this subbasin
3. Represents current combined set of key and priority subwatersheds as defined by PACFISH and INFISH criteria.
4. Redband trout are presumed present wherever steelhead are present.
5. Current KWS include all INFISH priority watersheds, as well as all PACFISH key watersheds.

Environmental Consequences to Species Viability Common to All Alternatives

All alternatives incorporate, to varying degrees, the plan components essential to assuring viability for surrogate species and the aquatic species they represent in National Forest System lands. These plan components include:

- Desired conditions and objectives for watershed condition and function, threatened and endangered species, and riparian and aquatic habitat conditions supporting surrogate species and the other native aquatic species represented by the surrogate species.
- Allocation of lands (management areas) considered either suitable or not suitable for grazing, timber management, and/or roaded access, including new road construction.
- Active restoration of riparian and aquatic habitats, roads and forest vegetation in priority watersheds over the life of the Plan.
- Watershed, riparian, and aquatic habitat protections provided by standards and guidelines, including protective measures that would control or eliminate undesirable non-native and invasive aquatic plant and animal species, which would direct management changes in grazing allotments where one or more surrogate species are present and/or conditions indicate management is not promoting desired conditions.
- Forest Plan-scale implementation and effectiveness monitoring strategies used to assess riparian and aquatic conditions and trends over time that would inform adaptive management decisions.

All of these components would be in place for all the plan revision alternatives, therefore management of National Forest System lands can be expected to contribute to viability of the various surrogate species that spawn and rear in National Forest System lands. The plan revision alternatives are strengthened further by establishment of riparian management areas as a land allocation and by standards and guidelines such as ones that ensure redds of listed fish would be protected from trampling by grazing livestock for all alternatives.

The suite of protections provided by desired conditions, standards and guidelines, and suitability determinations for timber production, grazing and road access tailored to each management area would facilitate passive restoration through natural processes, for aquatic and riparian habitats.

Under Alternatives B through F, additional protections related to construction of new roads would be provided by additional desired conditions, goals, standards, and guidelines specific to key watersheds. Under Alternative A, PACFISH and INFISH direction for key and priority watersheds would continue to apply to all subwatersheds where listed fish are present, as shown in Table 245. Protective effects from the alternatives are represented by protection scores, which were calculated through application of the Blue Mountains Aquatic Sustainability Model. The model assumptions and calculations are described in Gecy (2013a).

Relative protection levels for each species are presented by protection scores for that species. Habitat protections integrated into the alternatives through suitability determinations for the various management areas in each subbasin are represented by protection scores calculated through the model.

- Acres allocated to the various management areas, and their distribution within each subbasin where a species is present.

- Suitability for forest management, livestock grazing and roaded access for each management area.

Brief interpretations of the protection scores are provided by alternative in the tables that follow for each species. Passive restoration is considered to occur when protection scores are the same or greater than protection scores for Alternative A, because Alternative A is currently supporting ongoing passive restoration processes at nearly natural rates, based on forest plan level monitoring for riparian and aquatic habitat conditions (Archer et al 2016a-c).

Additional assumptions upon which the following effects analyses are based:

- The Revised Forest Plan will have no direct effects as the Plan is a programmatic action that is not tied to a specific place or location and does not authorize site-specific projects. Forest Plans influence what might or might not be proposed in the future and the nature of those actions.
- The Revised Forest Plans can indirectly affect habitat and populations for surrogate species, Threatened, Endangered and Sensitive species and other more common species sharing surrogate species habitats, since future projects will be expected to be consistent with applicable forest plan direction, including progress towards achieving desired watershed conditions in project areas, thereby indirectly influencing habitat for populations of aquatic species inhabiting those watersheds.
- The 2008 Regional Aquatic and Riparian Conservation Strategy as it was applied across Alternatives B through F, and the 2018 Blue Mountains Aquatic and Riparian Conservation Strategy, as it applies to Alternatives E-Modified and E-Modified Departure, contain more comprehensive sets of desired conditions, standards and guidelines, and objectives than included in PACFISH and INFISH) and are expected to be more effective at restoring ecologically healthy watersheds, riparian, and aquatic habitats, balancing and reducing risks to aquatic habitat conditions associated with management allocations deemed suitable for forest management, livestock grazing and/or roaded access. Those risks vary by alternative, by subbasin, by species and existing population and habitat conditions and trends. The relative risks posed by each alternative are disclosed in surrogate species analyses that follow.
- Most of the active restoration activities are assumed to occur in priority watersheds; accordingly, the aquatic surrogate species inhabiting those watersheds will all benefit long term from whole-watershed restoration in these watersheds, as stated in Appendix A of this document. Additional active restoration may occur opportunistically in non-priority watersheds as staffing, funding and partner support permit. Table 246 through Table 251 in the effects section, display 10- and 20-year projects for subwatersheds with measurable improvements in watershed condition at each time step. Metrics for watershed improvement in those tables demonstrate that work is likely to occur in more watersheds than are currently identified as either key or priority, at each time step. The extent to which no-priority watersheds on each national forest are likely to show net improvement, depends on the individual national forest, restoration work currently ongoing, and the time step in question.
- Active restoration in select priority subwatersheds is intended to complement and enhance riparian and aquatic habitat conditions and support passive restoration through ongoing natural processes in those subwatersheds. Active restoration is not intended to offset

degradation of riparian and aquatic habitats by land management that would detract from desired conditions for watershed function and aquatic species habitats.

Active and Passive Restoration Effects Common to All Alternatives

The degree to which alternatives would result in watershed and riparian improvements through protective measures associated with livestock grazing, forest management and access management provided by desired conditions, management allocations and their suitable uses, along with standards and guidelines, combined with active restoration of roads and upland vegetation, riparian and aquatic habitats based on objectives, will likely benefit aquatic species and their habitats in commensurate terms, through improved watershed function and natural disturbance processes that are closer to the long-term natural range of variability to which these species are adapted. Active restoration of riparian and aquatic habitats and improved connectivity through removal of passage barriers will result in more immediate benefits than work in uplands. The aquatic surrogate species inhabiting those watersheds will all benefit long term from whole-watershed restoration in these watersheds, though benefits of upland restoration will show up more slowly than the near-term benefits of restoration in aquatic and riparian habitats and reductions in hydrologic road connectivity.

Accelerated restoration in priority watersheds and perhaps additional key watersheds would also contribute to creating larger better-connected blocks of good-quality spawning and rearing habitats for one or more surrogate species within targeted subbasins. Larger areas of connected key watersheds and habitats would be well distributed within each forest, as priority and key watersheds in each forest are distributed between two or more subbasins in a similar number of major river basins: Middle Columbia, Lower Snake, Middle Snake and Oregon Closed Basins (Appendix B). This long-term improvement in watershed conditions in targeted subbasins would help offset any short-term detrimental effects from natural disturbances or from restoration activities within those subbasins, by providing well-distributed refugia from these disturbances. The more priority and other key watersheds that are restored, the more resilient the networks of habitat and populations are likely to be in the face of natural disturbance, and the more likely that plan activities will contribute to maintaining or restoring viability for surrogate species by providing well-distributed, accessible sizeable refugia from future disturbances.

Combinations of passive and active restoration that would improve habitat quality and connectivity are likely to be among the more effective restoration activities that could be undertaken near term for spring Chinook salmon and other surrogate species. In watersheds that have been fragmented by land management activities and infrastructure including historic placer mining, dams, culverts, or that indirectly caused loss of base flow or elevated water temperatures, connectivity could be increased by removing barriers associated with road crossings and diversion structures (Steel et al. 2004), restoring water tables and meadows for water storage to improve seasonal low flow conditions, or restoring stream shade that would alleviate high stream temperatures that can act as thermal barriers (Torgersen et al. 1999).

Watershed-scale restoration action plans have been completed for all 14 priority subwatersheds in the Granite and Wall Creek watersheds within the Umatilla National Forest, and for all 8 priority subwatersheds in the Camp Creek watershed within the Malheur National Forest, all done at the 5th-HUC watershed scale per direction in the 2005 Aquatic Restoration Strategy have also been completed for priority subwatersheds within the Imnaha and Upper Grande Ronde subbasins on the Wallowa-Whitman National Forest. Watershed Restoration Action Plans are developed or refined for individual subwatersheds when they are selected by forest staff on each national forest

as a national Watershed Condition Framework priority subwatershed targeted for restoration within the next 5 to 7 years. New Watershed Condition Framework watersheds are selected from among other priority watersheds once essential restoration work is completed in one or more current Watershed Condition Framework watersheds.

The degree to which active restoration would benefit individual surrogate species would depend on which priority watersheds are restored over the life of the plan, and the species present in those watersheds. The specific set of priority watersheds that would be restored under each alternative is unknown at this time, as there are more priority watersheds identified on each forest, than are likely to be completed under any of the alternatives. However, based on the distribution of current watersheds with ongoing restoration (Watershed Condition Framework watersheds), it is likely that bull trout and redband trout populations will benefit from active restoration in subbasins in which current Watershed Condition Framework watersheds are located on each forest. Snake River Basin steelhead and spring Chinook populations are also likely to benefit from active restoration in subbasins in which current Watershed Condition Framework watersheds are currently selected in the Umatilla and Wallowa-Whitman National Forests. Middle Columbia River steelhead in the North Fork John Day population are likely to benefit from restoration of Watershed Condition Framework watersheds currently selected and being restored on the Umatilla and Wallowa-Whitman National Forests, and watersheds restored on the Malheur National Forest will benefit the Middle Fork John Day population of Middle Columbia River steelhead as well.

Environmental Consequences to Surrogate Species Viability

Comparison of Active Restoration Outcomes among Alternatives for Aquatic Species

Analysis of effects to individual species for viability are required by law and policy. Active restoration would occur primarily in priority watersheds, and is expected to benefit aquatic species in the long-term, but the extent to which viability of each species is benefited is unknown, due to uncertainty as to which priority watersheds would be restored over the life of proposed Plan, since there are more priority watersheds currently identified than are likely to undergo active restoration efforts during the first decade of proposed Plan, and not all priority watersheds provide habitat for all four surrogate species, or for every federally-listed or sensitive species. In some alternatives, more restoration objectives have been set than could be achieved within the specified priority watersheds alone, those objectives will likely be achieved through additional restoration work in other key watersheds, and some restoration work may improve conditions in other watersheds not comprising any portion of the key watershed network at all, Some of those outcomes are evident in Table 246 through Table 251 on pages 58-61.

Effects to surrogate species and their habitats as a group, from active restoration, parallel the effects of active restoration of watersheds, including uplands as well as riparian and aquatic habitats, all of which contribute to improvement of watershed conditions. Active restoration is expected to improve watershed conditions, including riparian and fish habitat quantity, quality and connectivity for aquatic species the most rapidly. These near-term and longer-term effects to habitat, measured through improvements in watershed condition in the first and second decades, in turn are expected to affect viability of aquatic species populations in National Forest System lands.

Assumptions Common to all Alternatives with Respect to Active Restoration

- Replacement or removal of culverts currently creating problems for fish passage will also reduce hydrologic connectivity and reduce the risk of future sediment inputs from failures

at stream crossings, and improve habitat and population connectivity as well as connectivity within and between populations of the various surrogate species where they are present. The relative degree of active restoration for fish passage and other actions taken to increase habitat quantity and connectivity between stronghold watersheds for surrogate species, which would be anticipated under the alternatives in priority watersheds is described in Appendix A for each national forest. Table 183 for the Malheur National Forest in the "Watershed Function, Watershed Quality, and Water Uses" section of Volume 1, provides a list of the quantified aquatic and riparian restoration objectives for the Malheur from Appendix A, which were considered in the analyses for improved watershed condition class, as an example. The extent of fish passage restoration and increased habitat quantity and connectivity varies by alternative.

- Improvements in aquatic habitat connectivity will benefit one or more surrogate species wherever these activities are conducted. The extent to which any particular species will benefit, is unknown at this time. Benefits to any particular species will depend on which priority watersheds receive these improvements and whether the location of such improvements occurs in locations the species is either expected or known to use.
- Active restoration for stream shade, water quality, flow volume and riparian habitat are discussed in the Watershed section. Improvements in all these elements will benefit surrogate species wherever these activities are conducted. The extent to which any particular species will benefit, will depend on which priority watersheds receive these improvements beyond the Watershed Condition Framework watersheds completed in the first 5 to 7 years of Plan life, which is unknown at this time, other than for the Wallowa-Whitman, which expects to restore forest vegetation condition class in 26 of 28 priority watersheds irrespective of which alternative is selected. Accomplishment of other restoration activities in priority watersheds varies by alternative, even on the Wallowa-Whitman, where upgrades or removals of culverts impairing fish passage are expected to vary by alternative, as would other restoration activities, most of which would be expected to be undertaken in priority watersheds as essential restoration actions, depending on existing conditions in individual priority watersheds.

Restoration needs are subbasin-specific and species-specific. For example, according to the Middle Columbia steelhead Recovery Plan, while a number of recovery actions were identified including protection of spawning and rearing habitats, the greatest overall restoration needs in the three John Day River subbasins consist of active restoration of stream flow, (especially in the Lower John Day River itself), along with targeted [active] restoration of stream function in terms of aquatic structure and floodplain connectivity combined with restoration of associated riparian conditions (NMFS 2015, p. 18). Restoration of riparian conditions can be accomplished through protection (passive restoration), active [targeted] restoration or any combination thereof, as appropriate. This portion of the analysis is necessarily broader, due to limitations of the model used, and compares the extent to which priority and non-priority key watersheds as a group, would be improved at forest scale over the first 10 and 20 years of implementing the various alternatives. Based on their intended role in maintaining a well-connected network of high-quality aquatic habitats in sufficient amounts to support viable populations of surrogate species and the other species sharing their habitats, the assumption is that improving conditions in this group of watersheds is more meaningful than improving conditions in other watersheds in the Plan Area, for restoring threatened and endangered aquatic species, Forest Service sensitive species, and diverse communities of native aquatic species throughout each National Forest, which are represented by the suite of selected surrogate species.

The “Watershed Function, Watershed Quality, and Water Uses” section in Volume 1 provides detailed comparisons of alternatives specific to effects of the suite of aquatic and riparian restoration actions quantified for each alternative in Appendix A for each national forest. An example of the quantified objectives considered in the Watershed analysis for improved watershed conditions are presented in the “Watershed Function, Watershed Quality, and Water Uses” section of Volume 1, Table 183. That section also evaluates indicators for the specific effects of roads, timber management, riparian management area land allocations, livestock grazing and soils impacts. The numbers of watersheds with improved conditions, are the result of the aggregated improvements in all those factors, which are described in general terms here:

- Upslope conditions within watersheds are described in terms of expected changes in the condition of forested vegetation, hydrological connectivity of the road system, and livestock use intensity
- Differences in the effects of grazing on riparian habitats between alternatives
- Influence of differences in riparian habitat conservation areas and riparian management areas
- Influence of restoration actions on riparian, stream channel, and aquatic habitat conditions
- Extent of detrimental soil conditions resulting from expected levels of timber harvest
- Changes in overall watershed conditions, considering all of the above factors

Outcomes from implementation of these objectives assumes compliance with law, policy, standards and guidelines, Suitability determinations, and that implementing actions would be designed to meet desired conditions for riparian management areas and other desired conditions as applicable. Analysis for the factors listed above that influence overall watershed conditions was presented in the “Watershed” section in Volume 1 and will not be repeated here. Those comparisons are incorporated by reference in this section, as fish habitat is expected to benefit or degrade proportionate to changes in individual indicators and the degree to which they influence watershed conditions overall. The relative number of watersheds comprising the total key watershed network, including both priority and other key watersheds, with improved conditions serves as an indicator for effects of alternatives on aquatic habitats and the surrogate aquatic species using those habitats.

The tables and discussions that follow are specific to each national forest. They weigh upward trends in watershed conditions at years 10 and 20 holistically, incorporating effects of active management of grazing, riparian and upland rangeland vegetation, management of the road network, management objectives for forest vegetation and investments in stream channel and riparian restoration, which are expected, in aggregate, to result in changes to watershed conditions at subwatershed-scale, as the proposed Plan would be implemented under each alternative.

For reasons discussed in the “Watershed Function, Water Quality, and Water Uses” section, more key watersheds as well as additional non-key watersheds may be improved than are currently identified as Priority watersheds for active restoration. The Watershed section provides detailed discrete analyses of the changes in watershed conditions from changes in forest and riparian vegetation, investments in roads, the influence of livestock grazing, based on restoration objectives for roads and forest vegetation described in Appendix A, and livestock animal unit months provided under each alternative, also described in Appendix A. This section discusses the changes in watershed condition from the integrated influence of those specific land uses and restoration activities under each alternative. The reader is referred back to the watershed section for methods and results that disclose the relative influence of those individual factors on the

integrated effects of those factors discussed in this section. In summary, the results displayed and discussed here represent the integrated effects of active management based on restoration objectives for which ultimately provide habitat for aquatic species, and will not attempt to discuss the relative influences of forest management, road management or livestock grazing as they relate to overall improvements in watershed condition for key watersheds and the habitat they ultimately provide for the selected aquatic surrogate species.

The number of watersheds improved in Table 246 through Table 251 on pages 58-61 are described in categories meaningful in terms of their relevance to aquatic species diversity and each forest's ability to provide for well-distributed viable populations of aquatic species at forest scale: priority watersheds, other key watersheds (non-priority), total key watersheds, and all watersheds. In each category, the sum of watersheds improved represents the sum of watersheds in which condition improves by one condition class, from class 3 to 2 or from class 2 to 1, relative to the existing condition for watersheds in that category.

This discussion will expand beyond effects to priority watersheds, as it is the entire set of key watersheds which is intended to provide long-term population viability for the selected surrogate species and provide a range of watershed conditions that would sustain aquatic species ecological diversity across each of the National Forests for the long term, support recovery of federally listed and maintain viable populations of species on the Regional Forester's sensitive species list that were considered in this analysis. Many watersheds outside the key watershed networks provide additional critical habitat and support to recovery of federally listed species, and help to maintain viable populations of Sensitive species, therefore net gains in condition among all watersheds at forest scale were also considered, since measurable improvements in condition of these additional watersheds, provide additional benefits to fish populations at forest scale. Effects to individual surrogate species, as well as to individual federally listed or sensitive are based on additional analyses in the next section titled "Passive Restoration," which uses other metrics from the Aquatic Sustainability Model which can be analyzed at subbasin scales meaningful to each individual listed or sensitive species or which may fall into another category for analysis, or which may refine results for surrogates representing other species naturally limited to certain subbasins affected by individual forests. The aggregate changes in watershed conditions disclosed in this section do not contain sufficient information to discuss effects to individual species, but simply enable generalized conclusions regarding the diverse aquatic habitats and watershed conditions supporting aquatic species across each forest over the next 10 and 20 years.

Malheur National Forest – A total of 62 key watersheds have been identified on the Malheur National Forest for future management, through application of the Blue Mountains Aquatic Sustainability Model, the EMDS model adapted from Reiss et al (2008) as previously disclosed in the preceding "Watershed Function, Water Quality, and Water Uses" section of this document in Volume 1. Of the 62 key watersheds identified, 34 have been identified as high-priority for active restoration over the life of the Plan. Restoration objectives described in Appendix A, and presented again in Table 25 in the preceding Watershed Effects section are the basis for the expected 10 and 20-year results presented in Table 246 and Table 247 that follow, results that were calculated using the Blue Mountains Aquatic Sustainability Model. They are based on the same calculated model results shown in similar tables in the "Watershed Function, Watershed Quality, and Water Uses" section for all watersheds and for key watersheds identified as priorities for restoration (Table 187 through Table 190 in Volume 1, but expand on those discussions by also considering additional results for other key watersheds from the model, ones not currently identified as priority for restoration, as well as aggregate results for the entire key watershed network (model analyses, effects-compare_v_1-Feb-2018.xls, project record), in addition to using

results for priority watersheds and all watersheds, which were previously presented in the watershed section. Improvements in condition of these additional watersheds, particularly with respect to additional key watersheds, provide additional benefits to populations of aquatic species at the national forest scale.

Alternatives C and D, closely followed by the two E-Modified alternatives, would produce the fastest results in terms of priority watersheds improved in the first 10 years. Alternatives A and E would achieve intermediate rates of improvements in watershed condition for priority watersheds by year 10, while B and F would show the slowest results. Alternatives A and F would show additional, though limited gains in priority watershed conditions over the course of the second decade. Other alternatives would achieve no additional gains for priority watersheds in the second decade.

Further inspection of Table 246 and Table 247 discloses that with respect to all key watersheds as a group at year 10, Alternative C stands out as making the greatest improvements, followed closely by D, then by a middle group consisting of A and the two E-Modified alternatives, with much lesser improvements under E, B and F across the full key watershed network. Under Alternatives A, B, C, and D, all gains in watershed condition for key watersheds as a group, would be achieved in the first decade, with no additional key watersheds showing measurable improvement over the second decade.

Table 246. Number of subwatersheds improved (riparian/aquatic habitat/roads/upland vegetation) as of year 10 (Malheur National Forest)

Watershed Type	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. E-Mod.	Alt. E-Mod. Dep.	Alt. F
Priority key watersheds (PWS)	2	1	5	5	2	4	4	1
Other key watersheds (KWS)	5	2	4	3	3	3	3	2
Total key watersheds[1] (KPW)	7	3	9	8	5	7	7	3
All WS[2]	26	19	39	27	21	30	26	19

1. KPW=KWS+PWS. As previously noted, priority watersheds are a subset of all key watersheds.
2. WS = watersheds of all types, including ones outside the key watershed network.

Table 247. Number of subwatersheds (riparian/aquatic habitat/roads/upland vegetation) cumulatively improved within 20 years (Malheur National Forest)

Watershed Type	Alt A	Alt B	Alt C	Alt D	Alt E	Alt E-Mod.	Alt E-Mod. Dep.	Alt F
Priority key watersheds (PWS)	3	1	5	4	2	4	4	2
Other key watersheds (KWS)	4	2	4	4	4	6	5	2
Total key watersheds[1] (KPW)	7	3	9	8	6	10	9	4
All WS[2]	25	19	39	27	25	35	28	22

1. KPW =KWS+PWS. As previously noted, priority watersheds are a subset of all key watersheds.
2. WS = watersheds of all types, including ones outside the key watershed network.

By year 20 however, alternative E-Modified stands out as exhibiting the greatest improvements in key watersheds as a whole, followed by alternatives C and E-Modified Departure. Alternative A would slip slightly from improvements gained in the first 10 years, which is conceivable due to random disturbance events, which are built into the vegetation model, while alternative E would continue to gain ground. Alternatives B and F would progress at the slowest rates throughout the first and second decades with respect to overall improvements in watersheds.

At year 10 alternative C would result in the largest number of total watersheds improved, followed by alternative E-Modified. The remaining alternatives would all have fewer total watersheds with improved conditions at year 10, with B and F showing the slowest rates of progress.

A minor setback is expected to occur in aggregate condition outside the key network by year 20 under alternative A, which is conceivable due to random disturbance events, which are built into the vegetation model. By year 20, alternative C and E-Modified retain their leads over the other alternatives, all of which continue to gain condition across all watersheds due primarily to gains in condition in watersheds outside the key watershed network, with limited or no additional gains among key watersheds.

Umatilla National Forest – A total of 52 key watersheds have been identified on the Umatilla National Forest for future management, through application of the Blue Mountains Aquatic Sustainability Model. Of the 52 key watersheds identified, 15 have been identified as high-priority for active restoration over the life of the plan. Restoration objectives described in Appendix A, and presented again in Table 205 in the preceding Watershed Effects section of Volume 1 are the basis for the expected 10 and 20-year results presented in Table 248 and Table 249 that follow, results that were calculated using the Blue Mountains Aquatic Sustainability Model. They are based on the same calculated model results shown in similar tables in the "Watershed Function, Watershed Quality, and Water Uses" section (Table 209 through Table 212, Volume 1), but expand on those discussions by also considering additional results for other key watersheds, ones not currently identified as priority for restoration, as well as aggregate results for the entire key watershed network model (model analyses, effects-compare_v_1-Feb-2018.xls, project record), in addition to using results for priority watersheds and all watersheds, which were previously presented in the watershed section.

As displayed in Table 248 and Table 249, most of the priority watersheds (13 of 15) could exhibit improved conditions within 10 years in Alternative C, but a slight setback could occur by year 20, due to a random disturbance factor built into the vegetation model. All other alternatives would result in much lower numbers of priority watersheds with improved conditions both at year 10 and year 20, with limited or no gains after year 10.

At year 10 alternative C would result in the largest number of key watersheds improved, followed by alternative D, then a close cluster of E, the E-Modified alternatives and F. Alternatives A and B would display the slowest improvement rates at year 10.

Alternative C would show the most improvement in conditions throughout the key watershed network by year 20, though a slight setback in condition would potentially occur between year 10 and year 20 due to a random disturbance factor built into the vegetation model. Alternative D would show no additional improvement. A, E, F, E-Modified and E-Modified Departure would achieve all achieve additional gains in conditions, however Alternatives A, B and E would exhibit the fewest improvements in key watersheds at year 20.

Table 248. Number of subwatersheds improved (riparian/aquatic habitat/roads/upland vegetation) as of year 10 (Umatilla National Forest)

Watershed Type	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. E-Mod.	Alt. E-Mod. Dep.	Alt. F
Priority key watersheds (PWS)	2	3	13	4	4	4	4	4
Additional key watersheds (KWS)	5	7	14	13	6	5	7	6
Total key watersheds[1] (KPW)	7	10	27	17	10	9	11	10
All WS[2]	11	11	41	24	13	14	12	13

1. KPW = KWS+PWS. As previously noted, priority watersheds are a subset of all key watersheds.
2. WS = watersheds of all types, including ones outside the key watershed network.

Table 249. Number of watersheds improved (riparian/aquatic habitat/roads/upland vegetation) cumulatively within 20 years (Umatilla National Forest)

Watershed Type	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. E-Mod.	Alt. E-Mod. Dep.	Alt. F
Priority key watersheds (PWS)	2	4	12	4	4	4	4	5
Additional key watersheds (KWS)	10	9	14	13	9	12	12	13
Total key watersheds[1] (KPW)	12	13	26	17	13	16	16	18
All WS[2]	19	19	40	24	18	21	21	21

1. KPW=KWS+PWS. As previously noted, priority watersheds are a subset of all key watersheds.
2. WS = watersheds of all types, including ones outside the key watershed network.

At year 10 alternative C would result in the largest number of watersheds improved overall, followed by alternative D, then a close cluster of E, the E-Modified alternatives and F. Alternatives A and B would achieve the fewest total watersheds with improved condition. At year 20, alternative C would still result in the largest number of watersheds in improved condition in general, with a slight step back from gains achieved in year 10, which is conceivable due to random disturbance events, which are built into the vegetation model. Alternative D would retain second place, while all other action alternatives continue to gain in condition, but end up with close results to one another.

Wallowa-Whitman National Forest – A total of 96 key watersheds have been identified on the Wallowa-Whitman National Forest for future management, through application of the Blue Mountains Aquatic Sustainability Model. Of the 96 key watersheds identified, 26 have been identified as high-priority for active restoration over the life of the plan. Restoration objectives described in Appendix A and presented again in Table 227 in the preceding Watershed Effects section of Volume 1 are the basis for the expected 10 and 20 year results presented in Table 250 and Table 251 that follow, results which were calculated using the Blue Mountains Aquatic Sustainability Model. They are based on the same calculated model results shown in similar tables in the “Watershed Function, Watershed Quality, and Water Uses” section (Table 231 through Table 234, Volume 1, but expand on those discussions by also considering additional results for other key watersheds from the model, ones not currently identified as priority for restoration, as well as aggregate results for the entire key watershed network (model analyses,

effects-compare_v_1-Feb-2018.xls, project record), in addition to using results for priority watersheds and all watersheds, which were previously presented in the watershed section.

A wide range of improved conditions would occur among the 28 priority watersheds identified for the Wallowa-Whitman National Forest within the first 10 years of the Plan (Table 250), depending on the alternative. Again, the greatest improvements in priority watershed conditions would occur under Alternative C in the first decade, with only 1 priority watershed improved under alternative A, and a limited number of watershed with improved conditions across the other alternatives, with alternative D and E slightly gaining on B, F and the two E-Modified alternatives. Alternatives B, D, E and F would achieve limited additional gains among priority watersheds in the second decade, most notably by Alternative F; however, Alternative A would not improve further, while Alternative C would continue to exhibit much greater improvement than the other alternatives, though with limited gains over the first decade.

Table 250. Number of watersheds improved (riparian/aquatic habitat/roads/upland vegetation) as of year 10 (Wallowa-Whitman National Forest)

Watershed Type	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. E-Mod.	Alt. E-Mod. Dep.	Alt. F
Priority watersheds (PWS)	1	4	19	5	5	4	4	4
Additional key watersheds (KWS)	0	3	12	5	3	0	0	3
Total key watersheds[1] (KPW)	1	13	27	10	10	4	6	9
Total WS[2]	4	19	33	12	15	5	7	14

1. KPW = KWS+PWS. As previously noted, priority watersheds are a subset of all key watersheds.
2. WS = watersheds of all types, including ones outside the key watershed network.

Table 251. Number of watersheds improved (riparian/aquatic habitat/roads/upland vegetation) cumulatively within 20 years (Wallowa-Whitman National Forest)

Watershed Type	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. E-Mod.	Alt. E-Mod. Dep.	Alt. F
Priority key watersheds (PWS)	1	5	21	6	6	4	4	7
Additional key watersheds (KWS)	1	8	8	5	5	2	2	5
Total key watersheds[1] (KPW)	2	13	29	11	11	6	6	12
Other watersheds	4	8	7	4	6	2	7	5
Total WS[2]	6	21	36	15	17	8	13	17

1. KPW = KWS+PWS. As previously noted, priority watersheds are a subset of key watersheds.
2. WS = watersheds of all types, including ones outside the key watershed network.

A number of additional key watersheds would cumulatively add to the overall network of key watersheds that would experience improved watershed conditions under each alternative at 10 years, resulting in total key watershed network conditions gaining the most improvement under alternative C, followed at a distance by Alternative B, with Alternatives D, E and F running closely behind. The two E-Modified alternatives lag in terms of cumulative improvements to the key watershed network at year 10, and Alternative A shows no additional improvement beyond that achieved in priority watershed conditions.

At the 20-year mark in the key watershed network, Alternative C would retain the lead in improved conditions, with Alternatives B and F in second and third place respectively, closely followed by Alternatives D and E. The two E-Modified alternatives would show substantially little or no additional improvement comparatively speaking, and A would show almost no additional improvement over the first decade, and the least over the full 20 years.

In terms of all watersheds across the forest, the greatest number of watersheds improved at year 10 occurs under Alternative C. Alternative B follows at a distance, followed by Alternatives E, F and D. Alternatives A, E-Modified and E-Modified Departure show slow improvement in total watershed conditions, most of which would occur within the key watershed network and predominantly due to work done in those key watersheds prioritized for restoration investment.

The cumulative number of watersheds improved overall, increases slightly in all alternatives by year 20, with the greatest aggregate gains over the 20 years occurring under Alternative C, followed at a distance by alternative B, then by a loose cluster represented by Alternatives D, E, E-Modified Departure and F. Alternative A produces the least amount of watersheds with improved conditions, which are only slightly exceeded by Alternative E-Modified.

Passive Restoration

The Blue Mountains Aquatic Sustainability Model provides a means by which to assess protective aspects of alternatives to viability for individual species, and is consistent with regional direction for analyzing effects to viability for individual surrogate species. This model is based on the assumption that the level of risk of habitat degradation implied by land allocations considered suitable for livestock grazing, timber production and/or roaded access is counterbalanced by management allocations where these uses are considered not suitable. The degree to which allocations within a subbasin are not suitable for these uses is the degree to which the model considers aquatic habitat protected in that subbasin. The degree of protection represented by model protection scores is rated on a scale of 0 to 1.0, with 1.0 being the highest level of protection from these three major ground-disturbing land uses.

Protection from detrimental effects from land management activities is as critical to maintaining and restoring viability of individual surrogate species as is active restoration. These two aspects of restoration can complement one another on the same piece of ground, or may complement each other through application to non-overlapping acreages. Management Area allocations and suitability determinations provide protection through acreages determined not Suitable for uses (roads, grazing, timber production) that present potential risk to aquatic and riparian habitats and aquatic species. The benefits of those protective plan elements are displayed in relative terms in Table 252 through Table 263 in the following section, where further discussion is provided. Additional protections on lands determined to be suitable for these uses, are provided through desired conditions, standards and guidelines and monitoring. Those protective plan components are additive to the protections provided by management allocations and suitability determinations, and are not reflected in the referenced tables, but are discussed narratively in the following section. The Forest Plan desired conditions, suitable uses for riparian management areas and other land allocations, standards and guidelines for roaded access, threatened and endangered species, livestock grazing, timber management and other activities in riparian management areas, are all designed to work in an integrated fashion to protect water quality, fish habitat and support restoration through natural processes in all watersheds among the three Blue Mountains National Forests. This was the premise explicit in PACFISH and INFISH, (USDA-USDI 1995, Decision Notice); that passive restoration would begin to occur through natural processes in the absence of

further degradation, based on protections for riparian and aquatic habitats established through PACFISH and INFISH direction.

Methods by which protection scores for each subbasin were calculated are described in Reiss et al. (2008). This section uses protection score calculations from the Blue Mountains Aquatic Sustainability Model to discuss effects to individual surrogate species, and is the only systematic tool used in this revision capable of displaying effects to individual surrogate species or other sensitive species. These species are geographically limited to specific portions of each forest and limited to specific drainages.

As displayed in Table 252 through Table 263, the greatest differences in National Forest System management protective effects on viability would be between national forests, by species and/or by major river basin (Middle Columbia River versus Snake River Basin versus Oregon Closed Basins). In some cases, relative effects of alternatives may vary by distinct population segment, evolutionarily significant unit and/or by geographic management unit in the same national forest and relative effects of the alternatives on each species may be more related to whether the species occurs in the Snake River Basin or in the Middle Columbia River basin. These differences reflect different overall balances of land uses within each major river basin. In all cases, it is the mix of land allocations and balance of risk from timber production, livestock grazing and roaded access posed by alternatives, subbasin by subbasin, that creates relative differences in terms of protection and degree of risk from active management, for each species, as reflected in protection scores and rankings of alternatives in Table 252 through Table 263 that follow.

The following observations hold throughout the remainder of the analysis for species viability for each forest and for each individual surrogate species and each Sensitive species, including individual distinct population segments, evolutionarily significant units and/or geographic management units:

- Based on relative differences between protection scores among alternatives, with one exception (redband in the Middle Columbia River Geographic Area on the Malheur National Forest, discussed later in this section), Alternative C provides the greatest degree of protection, lowest risk of detrimental management effects to species viability from roads, grazing and timber production, and likely provides the most opportunity for natural processes to restore riparian and aquatic habitats throughout the range of each species. This alternative also poses the greatest risk of impacts from wildfire by allowing unnatural fuel conditions to continue to build in dry forest landscapes, relative to other alternatives.
- Based on relative differences between protection scores among alternatives, Alternative D poses the greatest degree of aggregate risk to riparian and aquatic habitats throughout the range of each species. This is based on differences between alternatives for levels of timber production, grazing and road construction/access based on suitability for those uses among the various management area allocations. The riparian management areas in this alternative are the narrowest of any of the alternatives, and carries the greatest risk of ground-disturbing land uses in close proximity to stream channels with attendant risk of degradation for water quality, riparian and aquatic habitat conditions. The risk is such that passive restoration through natural processes may be stalled or result in renewed degradation, a greater risk than that posed by other alternatives.
- As reflected in Table 252 through Table 263, relative habitat protections provided by alternatives vary by Forest and can also vary by evolutionarily significant unit, distinct population segment, or geographic management unit for the chosen surrogate species. The

relationship between these alternatives may vary by national forest, by individual species and/or by major drainage basin (such as Lower Snake River, Middle Snake River, Middle Columbia River, Oregon Closed Basins) within a national forest. Alternative C consistently provides the highest levels of protection, highest levels of support to passive restoration through natural processes, and lowest risk to viability among alternatives for each forest from management activities, for spring Chinook salmon throughout their range.

- The relative protective differences between Alternatives A, B, E, E-Modified, E-Modified Departure, and F based on protection scores would generally be small and show little risk of impact on viability for any of the species due to strong protections in place under each of those alternatives. The reduced levels of riparian vegetation use under Alternatives E and F add protections that are not reflected in Model protection scores for anadromous species and bull trout. Where protection scores suggest that Alternative E and F protective benefits are similar or less than benefits of Alternatives A or B, these additional protective benefits likely result in Alternatives E and F providing similar or greater benefits than Alternatives A and B.
- Alternatives E-Modified and E-Modified Departure contain revised utilization guidelines similar initially to utilization levels proposed in Alternative B, but which may be adjusted to become more conservative in some allotments in the plan area, pending the outcome of deeper analyses of subwatershed-scale water quality, riparian and aquatic habitat conditions that would be conducted within the first 5 years following a Plan decision. That potential is not reflected in protection scores in Table 252 through Table 263, as the potential for those increased levels of protection and risk reduction are speculative at this time for any particular watershed or subbasin, pending future analyses.
- PACFISH-INFISH Biological Opinion monitoring results show habitat recovery through natural processes under current PACFISH and INFISH management directions and additional protections provided by project-level Endangered Species Act consultations for grazing and other management activities (Alternative A). Monitoring data collected for the PACFISH-INFISH Biological Opinion Effectiveness Monitoring Program appears to show that riparian and aquatic habitat conditions in National Forest System lands in the Blue Mountains have improved since implementation of PACFISH and INFISH. Since the inception of monitoring in 2001 and based on repeat sampling of the sites through 2015, a few indicators are showing significant improvement, however most habitat and vegetation indicators appear to be showing no trend in condition. Indicators, which are not-yet displaying significant trends, may be slower to respond than those currently showing significant change. As monitoring continues, data may become sufficient to detect trends where none is evident yet. In Table 252 through Table 263 below, protection scores for each subbasin were summed to enable objective rankings of each alternative for the surrogate species analyzed. Protection scores for each subbasin are area-weighted based on the mix of management area allocations in each subbasin, with their determinations of Suitable uses in each management area and relative risks posed by the mix of uses in each subbasin, which are assigned protection scores for each suitable use and area-weighted at the subbasin scale. Alternative A is always the base ranking against which other alternatives are ranked in relative terms.
- Both Alternative E-Modified and E-Modified Departure would necessarily rely on consistent proactive effective implementation of standards and guidelines and best management practices to ensure that passive restoration already in progress under the current Plan as modified by PACFISH (Alternative A) continues.

- Increased grazing in currently vacant allotments in both E-Modified alternatives would increase risk from wider spread grazing use across the forest, and require additional administrative efforts to ensure no degradation of water quality, riparian function or fish habitat occurs and that passive restoration of these features through natural processes continues in the absence of degradation, including in watersheds where active restoration is not yet occurring.
- Many more acres are proposed for annual disturbance from timber management under Alternative E-Modified Departure within a much shorter timeframe than proposed under Alternative E-Modified. The increased activity described in E-Modified Departure, would additionally require a substantially expanded system of open roads for the duration of proposed Plan, to support the increased level of management activity. Given that set of conditions, the ability of currently limited available staff to ensure full, effective implementation of best management practices and to ensure full effective application of pertinent standards and guidelines on that many acres over the life of proposed Plan, would be extremely challenging, and would pose an elevated risk of soil erosion and water quality degradation and could potentially slow down rates of passive restoration through natural processes that are otherwise reflected in protection scores and the relative ranking of this alternative based on protection scores.

Spring Chinook Salmon

As shown in Table 252 through Table 254, relative effects of alternatives for spring Chinook salmon from habitat protections vary by National Forest and also depend on the spring Chinook salmon evolutionarily significant units in question.

Malheur National Forest – Passive Restoration: As reflected in the protection scores and interpretation shown in Table 252, Alternatives B, E, F and both E-Modified alternatives provide intermediate levels of protection and support for passive restoration and improved watershed conditions through landscape-scale natural processes.

Table 252. Malheur National Forest protection scores, anticipated habitat trends and relative restoration rates through natural processes for spring Chinook salmon, Middle Columbia River evolutionarily significant unit

Subbasin	Chinook Salmon Population Name	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E, Alt. F	Alt E-Mod., Alt E-Mod. Dep
Upper John Day	Upper John Day	0.62	0.68	0.77	0.54	0.66	0.69
Middle Fork John Day	Middle Fork John Day	0.56	0.60	0.71	0.44	0.57	0.59
	Sum of scores by alternative	1.18	1.28	1.48	0.98	1.23	1.28
	Ranking of scores *	1	3	4	0	2	3

* Protection scores represent the degree to which lands in the subbasin are considered unsuitable for grazing, timber management and/or roads, based on management area allocations. Higher scores indicate few acres are subject to risks associated with the three primary ground-disturbing uses with the most potential to negatively affect watershed health and fish habitat. Other Plan components must be considered before determining whether a trend is likely to occur, either positive or negative. The other plan components that provide protective elements for National Forest System lands and which contribute to passive restoration trends, include protective management actions designed to avoid deterring progress towards desired conditions, as well as standards and guidelines, watershed analysis, and adaptive management based on monitoring.

A greater number of acres are allocated under Alternatives E, F and the E-Modified alternatives, to management allocations considered suitable for one or more of the primary land uses in subbasins occupied by spring Chinook salmon, thereby increasing the risk of management effects to their habitat, relative to Alternative B. Because the model integrates multiple Plan components (suitabilities and allocations) and produces a protection score that integrates the associated management risks from all those factors at subbasin-scale, it is uncertain as to specifically which or how many aspects of Alternatives E, F, Alternative E-Modified and E-Modified Departure are outweighed by a corresponding aspect of Alternative B. Degree of risk and protection are subbasin-specific based on management allocations, their suitability for various land uses and the relative risks posed to riparian and aquatic habitats and overall watershed condition. Relative effects of Alternatives C and D in terms of passive restoration and its inverse (aggregate risk) were discussed in the general observations bullets listed above as prelude to the forest-specific discussions in this section.

Existing project-level biological opinions for grazing in the Malheur National Forest currently require greater reductions in riparian utilization and bank alternation under certain conditions than the guidelines given for Alternatives E and F, based on concerns for federally listed Middle Columbia River steelhead and bull trout. The new grazing guideline (GM-3G) proposed for Alternatives E-Modified and E-Modified Departure may ultimately result in similar reductions in riparian utilization and bank alteration on allotments or portions of allotments where subsequent project-level analysis determines that based on the weight of evidence among three core indicators used in the national Watershed Condition Framework: water quality, fish habitat, and/or riparian condition, a subwatershed is determined to be less than properly functioning within the allotment and there is evidence that livestock management is a contributing factor. In cases where those heightened requirements are applied, passive protection would increase and restoration through natural processes could be expected to proceed at a faster pace. Forest Plan-level monitoring would continue to collect data on conditions in the allotments with the intent to detect change in selected riparian and aquatic habitat indicators used for ongoing landscape-scale monitoring.

Umatilla National Forest – Passive Restoration: Relative effects of Alternatives C and D were discussed in the general observations bullets listed in the prelude to forest-specific discussions in this section and apply equally to Chinook salmon across the forest, whether in the Snake River Basin or in the Middle Columbia Basin region. For both evolutionarily significant units, Alternative D would provide the lowest degree of protection of all the alternatives and represents the greatest degree of risk to viability from active management and the lowest support for passive restoration through natural processes, whereas Alternative C offers the greatest levels of protection and support for passive restoration through natural processes throughout the national forest.

In the Middle Columbia Basin part of the forest, where no salmon are federally listed, Alternatives E and F would support stronger protections and support for non-listed Middle Columbia River spring Chinook salmon viability relative to alternatives A, B, or the two E-Modified alternatives, as reflected in the protection scores and interpretation shown in Table 253 below.

Results shown in Table 253 for Snake River Basin spring Chinook vary slightly from those for Middle Columbia Basin spring Chinook salmon in that Alternative B would provide greater protections and support faster rates of passive restoration through natural processes than would

occur under alternatives E and F, A or the two E-Modified alternatives for that Evolutionarily Significant Unit.

The new grazing guideline (GM-3G) proposed for Alternatives E-Modified and E-Modified Departure may ultimately result in reductions in riparian utilization and bank alteration on allotments or portions of allotments where subsequent project-level analysis determines that based on the weight of evidence among three core indicators used in the national Watershed Condition Framework: water quality, fish habitat, and/or riparian condition, a subwatershed is determined to be less than properly functioning within the allotment and there is evidence that livestock management is a contributing factor. In cases where those heightened requirements are applied, protection would increase and restoration through natural processes could be expected to proceed at a faster pace. Forest Plan-level monitoring would continue to collect data on conditions in the allotments with the intent to detect change in selected riparian and aquatic habitat indicators used for ongoing landscape-scale monitoring.

Table 253. Umatilla National Forest protection scores, anticipated habitat trends, and relative restoration rates through natural processes for spring Chinook salmon, Middle Columbia River and Snake River Basin evolutionarily significant units

Subbasin	Chinook Salmon Population Name	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E and F	Alt. E-Mod., Alt E-Mod. Dep.
Middle Columbia Basin ESU							
North Fork John Day	North Fork John Day	0.67	0.68	0.76	0.53	0.65	0.64
Umatilla	Umatilla	0.69	0.72	0.83	0.58	0.74	0.74
Walla Walla	Walla Walla	0.62	0.75	0.86	0.67	0.79	0.77
	Sum of scores by alternative	1.98	2.15	2.45	1.78	2.18	2.15
	Ranking of scores	1	2	4	0	3	2
Snake River Basin ESU							
Tucannon *	Tucannon	0.68	0.72	0.81	0.63	0.72	0.72
Lower Grande Ronde	Wenaha	0.82	0.82	0.84	0.77	0.81	0.83
Upper Grande Ronde	Upper Grande Ronde	0.61	0.63	0.74	0.46	0.60	0.59
	Sum of scores by alternative	2.11	2.17	2.39	1.86	2.13	2.14
	Ranking of scores*	1	4	5	0	2	3

* Protection scores represent the degree to which lands in the subbasin are considered suitable for grazing, timber management and/or roads, based on management area allocations. Higher scores indicate few acres are subject to risks associated with the three primary ground-disturbing uses with the most potential to negatively affect watershed health and fish habitat. Other Plan components must be considered before determining whether a trend is likely to occur, either positive or negative. The other plan components that provide protective elements for National Forest System lands and which contribute to passive restoration trends include desired conditions, as well as compliance with standards and guidelines, watershed analysis, and adaptive management based on monitoring.

Wallowa-Whitman National Forest – Passive Restoration: The relative effects of alternatives vary between evolutionarily significant units in the Wallowa-Whitman National Forest, based on protection scores and interpretation displayed in Table 254. For both evolutionarily significant units, Alternative D would provide the lowest degree of protection of all the alternatives and correspondingly represents the greatest degree of risk to viability from active management and consequently the lowest support for passive restoration through natural processes, whereas alternative C offers the greatest levels of protection and support for passive restoration through natural processes throughout the national forest.

Alternatives C and A would provide the stronger protections and associated rates of passive restoration for Middle Columbia River spring Chinook salmon, which may be attributable to little or no allocations to acres suitable to timber production or motorized access (MA4A and MA 3B) relative to other alternatives. Alternative D would provide the lowest level of protection and would potentially slow rates of restoration through natural processes when compared to Alternative A. Protection scores for Alternatives B, E and F suggest moderately increased risks to Middle Columbia River spring Chinook salmon protections compared to Alternative A.

Table 254. Wallowa-Whitman National Forest protection scores, anticipated habitat trends, and relative restoration rates through natural processes for spring Chinook salmon, Middle Columbia River and Snake River Basin evolutionarily significant units

Subbasin	Chinook Salmon Population Name	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E and F	Alt. E-Mod.	Alt. E-Mod. Dep.
Middle Columbia River ESU								
North Fork John Day	North Fork John Day	0.72	0.66	0.73	0.52	0.64	0.66	0.66
	Ranking of scores	3	2	4	0	1	2	2
Snake River Basin ESU								
Upper Grande Ronde	Upper Grande Ronde/ Catherine Creek	0.59	0.65	0.75	0.51	0.63	0.66	0.66
Wallowa	Lostine/ Minam	0.87	0.88	0.89	0.86	0.88	0.91	0.91
Imnaha	Imnaha	0.81	0.84	0.88	0.79	0.85	0.84	0.84
Hells Canyon	Hells Canyon	0.90	0.90	0.90	0.90	0.90	0.90	0.90
	Sum of scores by alternative	3.17	3.27	3.42	3.09	3.26	3.31	3.31
	Ranking of scores*	1	3	5	0	2	4	4

*Protection scores represent the degree to which lands in the subbasin are considered suitable for grazing, timber management and/or roads, based on management area allocations. Higher scores indicate few acres are subject to risks associated with the three primary ground-disturbing uses with the most potential to negatively affect watershed health and fish habitat. Other Plan components must be considered before determining whether a trend is likely to occur, either positive or negative. The other plan components that provide protective elements for National Forest System lands and which contribute to passive restoration trends include desired conditions, as well as compliance with standards and guidelines, watershed analysis, and adaptive management based on monitoring.

For federally threatened Snake River Basin spring Chinook salmon, Alternative B would provide stronger protections than Alternatives A, E and F. Both E-Modified alternatives would provide slightly more protection than Alternative B for this evolutionarily significant unit. The higher

protection scores for alternatives E-Modified and E-Modified Departure may reflect increased allocations to riparian management areas (MA4B) in the Upper and Lower Grande Ronde subbasins and more backcountry motorized (MA3B), which would limit timber production, while still allowing limited roaded access.

The new grazing guideline (GM-3G) proposed for Alternatives E-Modified and E-Modified Departure may ultimately result in reductions in riparian utilization and bank alteration on allotments or portions of allotments where subsequent project-level analysis determines that based on the weight of evidence among three core indicators used in the national Watershed Condition Framework: water quality, fish habitat, and/or riparian condition, a subwatershed is determined to be less than properly functioning within the allotment and there is evidence that livestock management is a contributing factor. In cases where those heightened requirements are applied, protection would increase and restoration through natural processes could be expected to proceed at a faster pace. Forest Plan-level monitoring would continue to collect data on conditions in the allotments with the intent to detect change in selected riparian and aquatic habitat indicators used for ongoing landscape-scale monitoring.

Bull Trout Viability (Columbia River Basin DPS)

Malheur National Forest – Passive Restoration: Based on protection scores shown in Table 255 for bull trout in the Malheur National Forest, Alternative A would maintain ongoing passive restoration through natural processes. Alternatives E, E-Modified, E-Modified Departure, and F would likely result in slight improvements in restoration rates achieved through natural processes due to fewer acres subject to ground disturbance compared to Alternative A. The lower protection score for Alternative D reflects potential reductions in riparian and aquatic habitat conditions and habitat recovery rates when compared to Alternative A.

Table 255. Malheur National Forest protection scores, habitat trends, and relative restoration rates for bull trout, Columbia River Basin distinct population segment

Subbasin	Bull Trout Population (Core Area) Name	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E, Alt. F	Alt. E-Mod.	Alt. E-Mod. Dep.
Malheur*	Upper Malheur	0.57	0.63	0.72	0.49	0.59	0.62	0.62
Malheur*	NF Malheur	0.57	0.63	0.72	0.49	0.59	0.62	0.62
Upper John Day**	Upper John Day	0.62	0.68	0.77	0.54	0.66	0.69	0.69
Upper John Day**	Indian Creek	0.62	0.68	0.77	0.54	0.66	0.69	0.69
Middle Fork John Day	Middle Fork John Day	0.56	0.60	0.71	0.44	0.57	0.59	0.59
	Sum of scores by alternative	2.94	3.22	3.69	2.36	3.07	3.21	3.21
	Ranking of scores**	1	4	5	0	2	3	3

* Protection scores were calculated for entire Upper Malheur subbasin. North Fork and Upper Malheur watershed protection scores are assumed to be similar to scores at subbasin scale.

** Protection scores represent the degree to which lands in the subbasin are considered suitable for grazing, timber management and/or roads, based on management area allocations. Higher scores indicate few acres are subject to risks associated with the three primary ground-disturbing uses with the most potential to negatively affect watershed health and fish habitat. Other Plan components must be considered before determining whether a trend is likely to occur, either positive or negative. The other plan components that provide protective elements for National Forest System lands and which contribute to passive restoration trends include desired conditions, as well as compliance with standards and guidelines, watershed analysis, and adaptive management based on monitoring.

Restoration through natural processes would likely happen fastest for Alternative C, overall, due to the fewest acres exposed to ground disturbing activities, with Alternative B providing the second highest rates of restoration through natural processes. Interpretation of the protection scores expects that Alternative C would provide the fastest upward trend in passive restoration. Alternatives E, F and E-Modified alternatives would provide stronger protections for bull trout viability relative to Alternatives A and D and would enable passive restoration to continue through natural processes, potentially at faster rates than would occur under Alternative A. Both E-Modified alternatives may produce somewhat faster rates of passive restoration than Alternatives E or F, for similar reasons.

Existing project-level biological opinions for grazing in the Malheur National Forest currently require greater reductions in riparian utilization and bank alteration under certain conditions than the guidelines given for Alternatives E and F, based on concerns for federally listed Columbia River bull trout and Middle Columbia River steelhead. The new grazing guidelines proposed for Alternatives E-Modified and E-Modified Departure may result in similar reductions in riparian utilization and bank alteration on allotments or portions of allotments where subsequent project-level analysis determines that one or more of three indicators used in the national Watershed Condition Framework: water quality, fish habitat, and/or riparian condition, are determined to be functioning at less than properly functioning levels within the allotment. In cases where those heightened requirements are applied, passive protection would increase and restoration through natural processes could be expected to proceed at a faster pace. Forest Plan-level monitoring would continue to collect data on conditions in the allotments with the intent to detect change in selected riparian and aquatic habitat indicators used for ongoing landscape-scale monitoring.

Umatilla National Forest – Passive Restoration: Based on protection for bull trout shown in Table 256 for the Umatilla National Forest, most of the alternatives generally provide stronger protections and a moderately positive influence on viability from plan protections, when compared to Alternative A. Alternative D in the Upper Grande Ronde would be an exception and suggests risks to the Grande Ronde population in terms of slowing progress currently being achieved through passive restoration under PACFISH, as reflected in the lower protection score than shown for Alternative A in that subbasin.

Overall, protection scores for Alternatives E and F suggest marginally less protections than for Alternative B, primarily due to the difference in management allocations between the alternatives along with differing degrees of suitability for timber production, grazing, and roads. However, the stronger standards for riparian grazing utilization would provide greater protections for bull trout under Alternatives E and F. Intermediate protection scores for the two E-Modified alternatives reflect the renewed use of allotments and/or pastures in the Tucannon, Asotin and Grande Ronde subbasins that are currently vacant and which would remain vacant under Alternatives B, E and F.

The new grazing guideline (GM-3G) proposed for Alternatives E-Modified and E-Modified Departure may ultimately result in reductions in riparian utilization and bank alteration on allotments or portions of allotments where subsequent project-level analysis determines that based on the weight of evidence among three core indicators used in the national Watershed Condition Framework: water quality, fish habitat, and/or riparian condition, a subwatershed is determined to be less than properly functioning within the allotment and there is evidence that livestock management is a contributing factor. In cases where those heightened requirements are applied, protection would increase and restoration through natural processes could be expected to proceed at a faster pace. Forest Plan-level monitoring would continue to collect data on

conditions in the allotments with the intent to detect change in selected riparian and aquatic habitat indicators used for ongoing landscape-scale monitoring.

Table 256. Umatilla National Forest protection scores, anticipated habitat trends and relative restoration rates through natural processes for bull trout, Columbia River Basin distinct population segment

DPS Subbasins	Bull Trout Population (core area) Name*	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E, Alt. F	Alt E-Mod.	Alt E-Mod. Dep.
North Fork John Day	North Fork John Day	0.67	0.68	0.76	0.53	0.65	0.64	0.64
Umatilla	Umatilla	0.69	0.72	0.83	0.58	0.74	0.74	0.74
Walla Walla	Walla Walla	0.62	0.75	0.86	0.67	0.79	0.77	0.77
Walla Walla	Touchet	0.62	0.75	0.86	0.67	0.79	0.77	0.77
Tucannon	Tucannon	0.68	0.72	0.81	0.63	0.72	0.72	0.72
Asotin	Asotin	0.67	0.64	0.73	0.49	0.61	0.59	0.59
Lower Grande Ronde	Lookingglass-Wenaha	0.82	0.82	0.84	0.77	0.81	0.83	0.83
Upper Grande Ronde	Lookingglass-Wenaha	0.61	0.63	0.74	0.46	0.60	0.59	0.59
	Sum of scores by alternative	5.38	5.71	6.43	4.8	5.71	5.65	5.65
	Ranking of scores**	1	3	4	0	3	2	2

*Lookingglass-Wenaha core area, as described in the Bull Trout Recovery Plan (USFWS 2015), was previously described as the Grande Ronde population (core area) (USFWS 2006, 2008).

** Protection scores represent the degree to which lands in the subbasin are considered suitable for grazing, timber management and/or roads, based on management area allocations. Higher scores indicate few acres are subject to risks associated with the three primary ground-disturbing uses with the most potential to negatively affect watershed health and fish habitat. Other Plan components must be considered before determining whether a trend is likely to occur, either positive or negative. The other plan components that provide protective elements for National Forest System lands and which contribute to passive restoration trends include desired conditions, as well as compliance with standards and guidelines, watershed analysis, and adaptive management based on monitoring

Wallowa-Whitman National Forest – Passive Restoration: Based on protection scores for bull trout shown in Table 257, Alternatives E and F would provide stronger protections and greater support for more passive restoration processes in bull trout habitat than Alternatives A and D, and only slightly less than Alternative B. Alternative C would contribute the most protections and support to improved viability through natural processes for bull trout within the Wallowa-Whitman National Forest. Alternatives A and D both would provide lower protection levels than Alternatives B, E, and F, primarily due to differences in management area allocations and suitability for timber production, grazing, and roads. Bull trout habitat in Brownlee subbasin is managed under the Hells Canyon National Recreation Area Comprehensive Management Plan, as would management in the Imnaha subbasin outside the Big Sheep Creek watershed. The comprehensive management plan has already gone through Plan-level analysis and Endangered Species Act consultation, and no changes in management are expected as a consequence of this decision for lands within the national recreation area.

The new grazing guideline (GM-3G) proposed for Alternatives E-Modified and E-Modified Departure may ultimately result in reductions in riparian utilization and bank alteration on allotments or portions of allotments where subsequent project-level analysis determines that based on the weight of evidence among three core indicators used in the national Watershed Condition Framework: water quality, fish habitat, and/or riparian condition, a subwatershed is determined to be less than properly functioning within the allotment and there is evidence that livestock management is a contributing factor. In cases where those heightened requirements are applied, protection would increase and restoration through natural processes could be expected to proceed at a faster pace. Forest Plan-level monitoring would continue to collect data on conditions in the allotments with the intent to detect change in selected riparian and aquatic habitat indicators used for ongoing landscape-scale monitoring.

Table 257. Wallowa-Whitman National Forest protection scores, anticipated habitat trend based on passive restoration through natural processes for bull trout, Columbia River Basin distinct population segment

DPS Subbasins	Bull Trout Population (core area) Name	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E, Alt. F	Alt E-Mod.	Alt E-Mod. Dep.
North Fork John Day (good)	North Fork John Day (32)	0.72	0.66	0.73	0.52	0.64	0.66	0.66
Upper Grande Ronde (fair)	Upper Grande Ronde (Catherine and Indian Creeks) (62)	0.59	0.65	0.75	0.51	0.63	0.66	0.66
Wallowa (fair)	Wallowa/ Minam (80)*	0.87	0.88	0.89	0.86	0.88	0.91	0.91
Wallowa (fair)	Little Minam (12)	0.87	0.88	0.89	0.86	0.88	0.91	0.91
Imnaha (fair)	Imnaha (76)	0.81	0.84	0.88	0.79	0.85	0.84	0.84
Brownlee (poor)	Brownlee (33)	0.75	0.78	0.84	0.71	0.78	0.77	0.77
Powder (fair)	Powder (21)	0.61	0.68	0.77	0.55	0.67	0.69	0.69
	Sum of scores by alternative	5.22	5.37	5.75	4.8	5.33	5.44	5.44
	Ranking of scores**	1	3	5	0	2	4	4

* Wallowa subbasin contains 2 core areas. Protection scores were run at subbasin scale, protection scores are assumed to apply equally in both core areas.

** Protection scores represent the degree to which lands in the subbasin are considered suitable for grazing, timber management and/or roads, based on management area allocations. Higher scores indicate few acres are subject to risks associated with the three primary ground-disturbing uses with the most potential to negatively affect watershed health and fish habitat. Other Plan components must be considered before determining whether a trend is likely to occur, either positive or negative. The other plan components that provide protective elements for National Forest System lands and which contribute to passive restoration trends include desired conditions, as well as compliance with standards and guidelines, watershed analysis, and adaptive management based on monitoring

Steelhead Viability (Middle Columbia River Distinct Population Segment)

Malheur National Forest – Passive Restoration: Effects to steelhead parallel effects to spring Chinook salmon discussed earlier, as these species use the same subbasins and will be affected by the same balances of land uses in the subbasin. The protection scores for Alternatives B, E, E-Modified, E-Modified Departure, and F indicate stronger support for steelhead viability relative to Alternatives A and D. The more restrictive riparian utilization guidelines for bull trout and anadromous watersheds in Alternatives E and F would further strengthen the protections indicated

by protection scores in Table 258, and may result in protections as strong or stronger than provided by Alternative B.

A greater number of acres are allocated under Alternatives E, F and the E-Modified alternatives, to management allocations considered suitable for one or more of the primary land uses in subbasins occupied by steelhead, thereby increasing the risk of management effects to their habitat, relative to Alternative B. Because the model integrates multiple Plan components (suitabilities and allocations) and produces a protection score that integrates the associated management risks from all those factors at subbasin-scale, it is uncertain as to specifically which or how many aspects of Alternatives E, F, Alternative E-Modified and E-Modified Departure are outweighed by a corresponding aspect of Alternative B. Degree of risk and protection are subbasin-specific.

Table 258. Malheur National Forest passive restoration scores and relative habitat trends for steelhead populations, Middle Columbia River Distinct Population Segment

DPS Subbasins	Steelhead Population Name	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E, Alt. F	Alt E-Mod.	Alt E-Mod. Dep.
Middle Fork John Day (good)	Middle Fork John Day (181)	0.56	0.60	0.71	0.44	0.57	0.59	0.59
Upper John Day (fair)	Upper John Day (161)	0.62	0.68	0.77	0.54	0.66	0.69	0.69
	Sum of scores by alternative	1.18	1.28	1.48	.98	1.23	1.28	1.28
	Ranking of scores*	1	3	4	0	2	3	3

* Protection scores represent the degree to which lands in the subbasin are considered suitable for grazing, timber management and/or roads, based on management area allocations. Higher scores indicate few acres are subject to risks associated with the three primary ground-disturbing uses with the most potential to negatively affect watershed health and fish habitat. Other Plan components must be considered before determining whether a trend is likely to occur, either positive or negative. The other plan components that provide protective elements for National Forest System lands and which contribute to passive restoration trends include desired conditions, as well as compliance with standards and guidelines, watershed analysis, and adaptive management based on monitoring.

Both E-Modified and E-Modified Departure display mixed results relative to protections provided by Alternative B, E and F. While it would likely maintain or improve existing conditions through natural processes and prevent further degradation of Middle Columbia River steelhead habitat in the Upper John Day subbasin, it may provide marginally less protection via land allocations and associated suitable uses in the Middle Fork John Day subbasin. Due to the fact that the Middle Fork John Day subbasin provides the majority of steelhead habitat on the Malheur National Forest (15 of 16 miles, Table 241), sustainability under both Alternative E-Modified and E-Modified Departure would necessarily rely on consistent proactive effective implementation of standards and guidelines and best management practices to ensure that passive restoration already in progress under the current Plan as modified by PACFISH (Alternative A) continues.

Existing project-level biological opinions for grazing in the Malheur National Forest currently require greater reductions in riparian utilization and bank alternation under certain conditions than the guidelines given for Alternatives E and F, based on concerns for federally listed Middle Columbia River steelhead and bull trout. The new grazing guidelines proposed for Alternatives E-Modified and E-Modified Departure may result in similar reductions in riparian utilization and

bank alteration on allotments or portions of allotments where subsequent project-level analysis determines that one or more of three indicators used in the national Watershed Condition Framework: water quality, fish habitat, and/or riparian condition, are determined to be functioning at less than properly functioning levels within the allotment. In cases where those heightened requirements are applied, passive protection would increase and restoration through natural processes could be expected to proceed at a faster pace. Forest Plan level monitoring would continue to collect data on conditions in the allotments with the intent to detect change in selected riparian and aquatic habitat indicators used for ongoing landscape-scale monitoring.

Umatilla National Forest – Passive Restoration: Effects to steelhead parallel effects to spring Chinook salmon discussed earlier, as these species use the same subbasins and will be affected by the same balances of land uses in the subbasin. The protection scores for Alternatives B, E and F indicate stronger support for steelhead viability relative to Alternatives A, D and the two E-Modified alternatives. The more restrictive riparian utilization guidelines for bull trout and anadromous watersheds in Alternatives E and F would further strengthen the protections indicated by protection scores in Table 259, and may result in protections as strong or stronger than provided by Alternative B. Reactivating livestock use in vacant allotments with contingent increases in risk, is reflected in protection scores for Alternatives E-Modified and E-Modified Departure.

For Middle Columbia River steelhead, Alternative D would provide stronger protections than Alternative A, in the Walla Walla subbasin and in the North Fork John Day subbasin. The reason for Alternative D outweighing Alternative A in the model protection scores may reflect increased acres allocated to Municipal Watershed management area (2J), which receives extremely high protections from active management to conserve drinking water quality for the city of Walla Walla and surrounding area. For the distinct population segment as a whole, Alternatives E and F would both provide the greatest levels of protection and support for passive restoration relative to Alternatives B, C, or either of the E-Modified alternatives. Protective aspects of Alternative B would be slightly more than those provided by either of the E-Modified alternatives.

Protection scores in Table 259 show a different pattern for Snake River Basin steelhead when comparing Alternatives B, E, and F than for Middle Columbia River steelhead. Alternative B would provide stronger protections than Alternatives E and F for the Snake River Basin steelhead distinct population segment, which may be explained by the shifting balance of land allocations in the Lower Grande Ronde subbasin in terms of more acres in riparian management areas under Alternative D. Protections under Alternative A would be consistently stronger than those provided under Alternative D, E or F, as well as stronger than protections provided under alternative E-Modified or E-Modified Departure when summed for all subbasins, primarily due to a balance of allocations that would reduce risks from roads and timber production. The stronger protections in alternatives B and A would provide greater support for passive restoration through natural processes, relative to the other alternatives.

The new grazing guideline (GM-3G) proposed for Alternatives E-Modified and E-Modified Departure may ultimately result in reductions in riparian utilization and bank alteration on allotments or portions of allotments where subsequent project-level analysis determines that based on the weight of evidence among three core indicators used in the national Watershed Condition Framework: water quality, fish habitat, and/or riparian condition, a subwatershed is determined to be less than properly functioning within the allotment and there is evidence that

livestock management is a contributing factor. In cases where those heightened requirements are applied, protection would increase and restoration through natural processes could be expected to proceed at a faster pace. Forest Plan-level monitoring would continue to collect data on conditions in the allotments with the intent to detect change in selected riparian and aquatic habitat indicators used for ongoing landscape-scale monitoring.

Table 259. Umatilla National Forest protection scores, anticipated habitat trends and relative restoration rates through natural processes for steelhead populations, Middle Columbia River and Snake River Basin distinct population segment

DPS Subbasins	Steelhead Population Name	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E, Alt. F	Alt. E-Mod.	Alt. E-Mod. Dep.
Middle Columbia River DPS								
North Fork John Day	North Fork John Day	0.67	0.68	0.76	0.53	0.65	0.64	0.64
Lower John Day	Lower John Day	0.53	0.59	0.68	0.39	0.55	0.52	0.52
Umatilla (fair)	Umatilla	0.69	0.72	0.83	0.58	0.74	0.74	0.74
Walla Walla	Walla Walla	0.62	0.75	0.86	0.67	0.79	0.77	0.77
Walla Walla	Touchet	0.62	0.75	0.86	0.67	0.79	0.77	0.77
	Sum of scores by alternative	3.13	3.49	3.99	2.84	4.16	3.44	3.44
	Ranking of scores*	1	3	4	0	5	2	2
Snake River Basin DPS								
Tucannon	Tucannon	0.68	0.72	0.81	0.63	0.72	0.72	0.72
Asotin	Asotin	0.67	0.64	0.73	0.49	0.61	0.59	0.59
Lower Grande Ronde	Wenaha	0.82	0.82	0.84	0.77	0.81	0.83	0.83
Upper Grande Ronde	Upper Grande Ronde	0.61	0.63	0.74	0.46	0.60	0.59	0.59
	Sum of scores by alternative	2.78	2.81	3.12	2.35	2.74	2.73	2.73
	Ranking of scores*	3	4	5	0	2	1	1

* Protection scores represent the degree to which lands in the subbasin are considered suitable for grazing, timber management and/or roads, based on management area allocations. Higher scores indicate few acres are subject to risks associated with the three primary ground-disturbing uses with the most potential to negatively affect watershed health and fish habitat. Other Plan components must be considered before determining whether a trend is likely to occur, either positive or negative. The other plan components that provide protective elements for National Forest System lands and which contribute to passive restoration trends include desired conditions, as well as compliance with standards and guidelines, watershed analysis, and adaptive management based on monitoring.

Wallowa-Whitman National Forest – Passive Restoration: Discussions for Middle Columbia River steelhead and Snake River Basin steelhead parallel previous discussions for Middle Columbia River and Snake River Basin spring Chinook salmon, as these distinct population segments each occupy the same set of subbasins respectively. Protective effects of the allocations, suitable uses, desired conditions, watershed analysis and effective implementation of standards

and guidelines will likely affect aquatic habitats similarly at subbasin and forest scales (Table 260).

The new grazing guideline (GM-3G) proposed for Alternatives E-Modified and E-Modified Departure may ultimately result in reductions in riparian utilization and bank alteration on allotments or portions of allotments where subsequent project-level analysis determines that based on the weight of evidence among three core indicators used in the national Watershed Condition Framework: water quality, fish habitat, and/or riparian condition, a subwatershed is determined to be less than properly functioning within the allotment and there is evidence that livestock management is a contributing factor. In cases where those heightened requirements are applied, protection would increase and restoration through natural processes could be expected to proceed at a faster pace. Forest Plan-level monitoring would continue to collect data on conditions in the allotments with the intent to detect change in selected riparian and aquatic habitat indicators used for ongoing landscape-scale monitoring.

Table 260. Wallowa-Whitman National Forest protection scores, anticipated habitat trends and relative restoration rates through natural processes for steelhead, Middle Columbia River and Snake River Basin distinct population segment

DPS Subbasins	Steelhead Population Name	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E, Alt. F	Alt E-Mod.	Alt E-Mod. Dep.
Middle Columbia River DPS								
North Fork John Day	North Fork John Day	0.72	0.66	0.73	0.52	0.64	0.66	0.66
	Ranking of scores*	3	2	4	0	1	2	2
Snake River Basin DPS								
Hells Canyon	Hells Canyon	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Lower Grande Ronde	Joseph	0.58	0.67	0.79	0.53	0.65	0.64	0.64
Upper Grande Ronde	Upper Grande Ronde	0.59	0.65	0.75	0.51	0.63	0.66	0.66
Wallowa	Wallowa	0.87	0.88	0.89	0.86	0.88	0.91	0.91
Imnaha	Imnaha	0.81	0.84	0.88	0.79	0.84	0.85	0.85
	Sum of scores by alternative	3.75	3.94	4.21	3.59	3.9	3.96	3.96
	Ranking of scores*	1	3	5	0	2	4	4

* Protection scores represent the degree to which lands in the subbasin are considered suitable for grazing, timber management and/or roads, based on management area allocations. Higher scores indicate few acres are subject to risks associated with the three primary ground-disturbing uses with the most potential to negatively affect watershed health and fish habitat. Other Plan components must be considered before determining whether a trend is likely to occur, either positive or negative. The other plan components that provide protective elements for National Forest System lands and which contribute to passive restoration trends include desired conditions, as well as compliance with standards and guidelines, watershed analysis, and adaptive management based on monitoring.

Redband Trout

Malheur National Forest – Passive Restoration: As reflected in the protection scores for redband trout and interpretations displayed in Table 261 for the Malheur National Forest, degree of risk and protection are subbasin-specific, as are miles of habitat affected by land allocations and suitability of ground-disturbing uses, hence the relative balance of protections and risk to redband trout vary between alternatives depending on the subbasin in question.

Redband trout in the South Fork Crooked River/Beaver Creek population are members of the Deschutes geographic management unit (GMU). While protection scores were not evaluated for this geographic management unit in the Draft Environmental Impact Statement, they have now been calculated and results presented in Table 261. This is the only area where Alternative A would provide stronger protections and more strongly promote passive restoration through natural processes, relative to any of the other alternatives, even Alternative C. This difference may be a result of management area reallocations among the action alternatives towards land allocations that provide for increased acreages suitable for ground-disturbing management activities.

Table 261. Malheur National Forest protection scores, anticipated habitat trends, and relative restoration rates for interior redband trout, Middle Columbia River, Deschutes, Middle Snake, Oregon Closed Basins geographic management units

Redband GMU subbasins and populations	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E, Alt. F	Alt E-Mod., Alt. E-Mod-Dep
Middle Columbia River GMU						
Upper John Day	0.62	0.68	0.77	0.54	0.66	0.69
North Fork John Day	0.54	0.60	0.68	0.46	0.57	0.60
Middle Fork John Day	0.56	0.60	0.71	0.44	0.57	0.59
Sum of scores by alternative	1.72	1.88	2.16	1.44	2.49	1.88
Ranking of scores*	1	2	3	0	4	2
Deschutes GMU						
South Fork Crooked River/Beaver Creek (NFS)	0.66	0.56	0.62	0.40	0.52	0.55
Ranking of scores*	5	3	4	0	1	2
Middle Snake GMU						
Upper Malheur	0.57	0.63	0.72	0.49	0.59	0.62
Ranking of scores	1	4	5	0	2	3
Oregon Closed Basins GMU						
Silvies	0.49	0.58	0.66	0.42	0.54	0.57
Silver	0.53	0.59	0.68	0.43	0.56	0.59
Harney-Malheur Lakes	0.57	0.56	0.69	0.40	0.52	0.55
Sum of scores by alternative	1.59	1.73	2.03	1.25	1.62	1.77
Ranking of scores*	1	3	5	0	2	4

* Protection scores represent the degree to which lands in the subbasin are considered suitable for grazing, timber management and/or roads, based on management area allocations. Higher scores indicate few acres are subject to risks associated with the three primary ground-disturbing uses with the most potential to negatively affect watershed health and fish habitat. Other Plan components must be considered before determining whether a trend is likely to occur, either positive or negative. The other plan components that provide protective elements for National Forest System lands and which contribute to passive restoration trends include desired conditions, as well as compliance with standards and guidelines, watershed analysis, and adaptive management based on monitoring.

Alternative A would provide minimal protections for all redband trout geographic management unit other than the Deschutes (Crooked River-Beaver Creek subbasin), compared to Alternatives B, E, E-Modified, E-Modified Departure, and F. Otherwise, Alternatives B, E, E-Modified, E-Modified Departure, and F would all provide stronger levels of grazing protection for populations throughout the Middle Columbia River, Malheur Lakes and Middle Snake River Basin geographic management units compared to protections provided by Alternative A for those areas . Alternative B provides variable degrees of protection relative to Alternatives E, F and the two E-Modified alternatives, depending on the redband trout geographic management unit.

Alternatives E and F would provide the strongest protections among all alternatives for the Middle Columbia Basin geographic management unit. Protections provided under Alternatives E and F, by alternative-specific grazing utilization standards for bull trout would concurrently provide protections for redband trout sharing bull trout subwatersheds in the Middle Columbia River and Middle Snake River geographic management areas. The benefits provided by those utilization standards would be offset by the balance of land allocations and suitable uses in the Middle Snake River (Upper Malheur subbasin). Without the balance provided by the grazing utilization guidelines for Alternatives E and F or for the two E-Modified alternatives, Alternative B would otherwise provide stronger protections than E, F, or either of the two E-Modified alternatives.

The populations in the Oregon Closed Basins geographic management unit would experience higher levels of protection under each of the E-Modified alternatives, second only to protections provided by Alternative C. These populations have been classified as a separate subspecies and proposed for listing under the Endangered Species Act, though listing has not been determined to be warranted. They are component populations of the only Geographic Management Unit (Oregon Closed Basins) that was categorized as a Sensitive species on the Regional Forester's sensitive species list as of 2011.

Existing project-level biological opinions for grazing in the Malheur National Forest currently require greater reductions in riparian utilization and bank alternation under certain conditions than the guidelines given for Alternatives E and F. Those biological opinions already benefit redband trout populations where they co-occur with federally listed species. The new grazing guidelines proposed for Alternatives E-Modified and E-Modified Departure may result in similar reductions in riparian utilization and bank alteration on allotments or portions of allotments in watersheds where federally listed species are absent, in the event that subsequent project-level analysis determines that one or more of three indicators used in the national Watershed Condition Framework: water quality, fish habitat, and/or riparian condition, are determined to be functioning at less than properly functioning levels within the allotment. In watersheds where those heightened requirements under GM-3G are applied, passive protection would increase and restoration through natural processes could be expected to proceed at a faster pace. If those adjustments are found warranted in watersheds in the Oregon Closed Basins or Upper Malheur River subbasin during future project analyses, redband trout populations not currently protected by Biological Opinions for steelhead or bull trout would potentially receive increased protections beyond those currently provided. Forest Plan level monitoring would continue to collect data on conditions in the allotments with the intent to detect change in selected riparian and aquatic habitat indicators used for ongoing landscape-scale monitoring.

Umatilla National Forest – Passive Restoration: For the Middle Columbia River geographic management unit, effects to redband parallel earlier discussions for Middle Columbia River steelhead in these same subbasins. For redband in the Lower Snake River geographic

management unit, protective effects of each alternative parallel the protective effects to Snake River Basin steelhead in these subbasins (Table 262). Umatilla National Forest protection scores, anticipated habitat trends and relative restoration rates through natural processes for interior redband trout, Middle Columbia River and Lower Snake geographic management units.

The new grazing guideline (GM-3G) proposed for Alternatives E-Modified and E-Modified Departure may ultimately result in reductions in riparian utilization and bank alteration on allotments or portions of allotments where subsequent project-level analysis determines that based on the weight of evidence among three core indicators used in the national Watershed Condition Framework: water quality, fish habitat, and/or riparian condition, a subwatershed is determined to be less than properly functioning within the allotment and there is evidence that livestock management is a contributing factor. In cases where those heightened requirements are applied, protection would increase and restoration through natural processes could be expected to proceed at a faster pace. Forest Plan-level monitoring would continue to collect data on conditions in the allotments with the intent to detect change in selected riparian and aquatic habitat indicators used for ongoing landscape-scale monitoring.

Table 262. Umatilla National Forest protection scores, anticipated habitat trends, and relative restoration rates through natural processes for interior redband trout, by geographic management unit

Redband GMUs and component populations by subbasin	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E, Alt. F	Alt. E.-Mod., Alt. E-Mod-Dep.
Middle Columbia River GMU						
North Fork John Day	0.67	0.68	0.76	0.53	0.65	0.64
Umatilla	0.69	0.72	0.83	0.58	0.74	0.74
Walla Walla	0.62	0.75	0.86	0.67	0.79	0.77
Lower John Day	0.53	0.59	0.68	0.39	0.55	0.52
Sum of scores by alternative	2.51	2.74	3.13	2.17	2.73	2.67
Ranking of scores*	1	4	5	0	3	2
Lower Snake River GMU						
Tucannon	0.68	0.72	0.81	0.63	0.72	0.72
Asotin	0.67	0.64	0.73	0.49	0.61	0.59
Lower Grande Ronde	0.82	0.82	0.84	0.77	0.81	0.83
Upper Grande Ronde	0.61	0.63	0.74	0.46	0.60	0.59
Sum of scores by alternative	2.78	2.81	3.12	2.35	2.74	2.73
Ranking of scores*	3	4	5	0	2	1

* Protection scores represent the degree to which lands in the subbasin are considered suitable for grazing, timber management and/or roads, based on management area allocations. Higher scores indicate few acres are subject to risks associated with the three primary ground-disturbing uses with the most potential to negatively affect watershed health and fish habitat. Other Plan components must be considered before determining whether a trend is likely to occur, either positive or negative. The other plan components that provide protective elements for National Forest System lands and which contribute to passive restoration trends include desired conditions, as well as compliance with standards and guidelines, watershed analysis, and adaptive management based on monitoring.

Wallowa-Whitman National Forest – Passive Restoration: Based on protection scores for interior redband trout shown in Table 263 for the Wallowa-Whitman National Forest, Alternative C would contribute the most to improved viability for redband trout through passive restoration, followed by Alternatives B, E and F, then by Alternative A in all geographic management units except the Lower Snake River geographic management unit.

Protections provided to the Middle Columbia River and Lower Snake River geographic management unit populations parallel effects to Middle Columbia River and Snake River Basin steelhead, previously discussed. Relative protective effects to redband in the Powder and Burnt River geographic management units from alternatives parallel the relative effects to Middle Columbia River redband, due to similar balances of land allocations and land use suitabilities. Increased riparian grazing utilization protections afforded to bull trout watersheds would not apply under Alternative F for the Burnt River geographic management unit, and increased riparian grazing utilization protections afforded to anadromous watersheds would not apply under Alternative E for the Powder River geographic management unit.

Table 263. Wallowa-Whitman National Forest protection scores, anticipated habitat trends, and relative restoration rates through natural processes for interior redband trout, by geographic management unit

Redband GMUs and component populations by subbasin	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E, Alt. F	Alt. E.-Mod.	Alt. E-Mod. Dep.
Lower Snake River GMU							
Hells Canyon	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Asotin	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Lower Grande Ronde	0.58	0.67	0.79	0.53	0.65	0.64	0.64
Upper Grande Ronde	0.59	0.65	0.75	0.51	0.63	0.66	0.66
Wallowa-Minam	0.87	0.88	0.89	0.86	0.88	0.91	0.91
Imnaha	0.81	0.84	0.88	0.79	0.85	0.84	0.84
Sum of scores by alternative	4.65	4.84	5.11	4.49	4.81	4.85	4.85
Ranking of scores*	1	3	4	0	2	4	4
Middle Snake River GMU							
Brownlee	0.75	0.78	0.84	0.71	0.78	0.77	0.77
Sum of scores by alternative							
Ranking of scores*	1	3	4	0	3	2	2
Powder GMU							
Powder	0.61	0.68	0.77	0.55	0.67	0.69	0.69
Burnt	0.53	0.59	0.68	0.43	0.57	0.59	0.59
Sum of scores by alternative	1.14	1.27	1.45	.98	1.26	1.28	1.28
Ranking of scores*	1	3	5	0	2	4	4
Middle Columbia River GMU							
North Fork John Day	0.72	0.66	0.73	0.52	0.64	0.66	0.66
Ranking of scores*	3	2	4	0	1	2	2

* Protection scores represent the degree to which lands in the subbasin are considered suitable for grazing, timber management and/or roads, based on management area allocations. Higher scores indicate few acres are subject to risks associated with the three primary ground-disturbing uses with the most potential to negatively affect watershed health and fish habitat. Other Plan components must be considered before determining whether a trend is likely to occur, either positive or negative. The other plan components that provide protective elements for National Forest System lands and which contribute to passive restoration trends include desired conditions, as well as compliance with standards and guidelines, watershed analysis, and adaptive management based on monitoring.

The new grazing guidelines proposed for Alternatives E-Modified and E-Modified Departure may result in reductions in riparian utilization and bank alteration on allotments or portions of allotments in watersheds where federally listed species are absent, in the event that subsequent project-level analysis determines that one or more of three indicators used in the national Watershed Condition Framework: water quality, fish habitat, and/or riparian condition, are determined to be functioning at less than properly functioning levels within the allotment. In watersheds where those heightened requirements under GM-3G are applied, passive protection would increase and restoration through natural processes could be expected to proceed at a faster pace. If those adjustments are found warranted in watersheds above Hells Canyon Dam during future project analyses, redband trout populations not currently protected by management protective of Chinook salmon, steelhead or bull trout would potentially receive increased protections beyond those currently provided. Forest Plan level monitoring would continue to collect data on conditions in the allotments with the intent to detect change in selected riparian and aquatic habitat indicators used for ongoing landscape-scale monitoring.

Environmental Consequences to Threatened and Endangered Species and Designated Critical Habitats

Snake River Basin spring, summer and fall Chinook salmon are all listed as threatened under the Endangered Species Act, as are Middle Columbia River steelhead and Columbia River bull trout. Under the Act, threatened species, by definition, are “likely to become endangered.” Until population numbers are sufficiently recovered for the relevant populations, as prescribed in recovery plans for these species, they will remain listed as threatened under the Endangered Species Act. The National Marine Fisheries Service is the agency responsible for delisting listed anadromous species when their populations have sufficiently recovered, based on criteria established in the recovery plans, which described the threats to each listed species and remedies to resolve those threats. The U.S. Fish and Wildlife Service is the agency responsible for delisting listed non-anadromous species when their populations have sufficiently recovered, based on criteria established in the recovery plans, which described the threats to each listed species and remedies to resolve those threats. Both U.S. Fish and Wildlife Service and National Marine Fisheries Service publish population status and trend information in recovery plans and in 5-year status reviews that assess progress in reducing identified threats, including threats outside of National Forest System lands or outside of Forest Service authorities. The most recent status reviews and recovery plans are cited as the source for status and trend information in Table 241 through Table 243 earlier; see table footnotes. Threat information is extremely detailed in the source documents, more than can reasonably be repeated here, and thus is incorporated by reference. Grazing management, forest management, road management, water use and other land management concerns are identified as threats in those documents, and have been identified as threats needing to be addressed on National Forest System lands as well as other ownerships, to the extent possible within Forest Service authorities and consistent with its multiple-use mission.

All of the plan alternatives may affect listed species or their designated critical habitats. Effects of projects implemented for any of the alternatives are expected to move the Plan Area towards desired conditions for watershed function and species diversity and viability, as described in Appendix A to this document. Rate of progress towards desired conditions would vary by alternative. Active restoration may have short-term effects for any alternative, but the magnitude of those effects at any point in time is likely to be localized as restoration work would not happen in all priority or key watersheds at the same time. The duration of effects would vary by activity, and would also depend on the sequencing of multiple restoration activities. As restored

watersheds accumulate over time, fish and habitats would likely respond in positive ways to those restoration activities in subsequent decades, particularly in the watersheds targeted as priority for restoration that serve to create larger blocks of high-quality, well-connected habitat, and increase the number of refugia available to offset large disturbances elsewhere such as fires or floods. The effects of roads on streams are documented in the "Watershed Function, Water Quality, and Water Uses" section of this document. Increased protections related to roads, new standards and guidelines, and/or desired conditions specific to federally listed species have been included in Alternatives B, C, E, E-Modified, E-Modified Departure, and F prohibiting construction of new roads and trails in high elevation riparian areas, adding protection for bull trout and other listed species spawning in high elevation streams. In addition, no increases in road density would be allowed in key watersheds, which would be more beneficial to aquatic species than current requirements under PACFISH or INFISH.

The objectives for road improvements in Alternative D (Appendix A) would potentially allow for increased maintenance and reconstruction of problem roads relative to the other alternatives, and in relative terms, would thereby reduce road-related water-quality impacts from sediment delivery, and reduce fish passage impacts by culvert upgrades based on current standards for fish passage design. The effects of grazing on streams and aquatic species are well documented. Cattle and sheep can have negative effects when they are in streams, depositing excess nutrients and trampling spawning beds and stream banks. Grazing in riparian zones can reduce vegetation and tree recruitment, affecting stream temperature and sediment delivery via removal of shade and compacted soils (Platts 1991, Armour et al. 1994, Bohn and Kershner 2002).

Plan standards and guidelines for grazing in any of the plan revision alternatives would require grazing to be managed in a way that would avoid redd trampling, and to be managed in ways that would move riparian and aquatic habitats towards desired conditions. While grazing may affect listed species or designated critical habitats, those effects may be reduced as grazing would be managed to meet and maintain desired conditions. Current management is already resulting in improving riparian and aquatic habitat conditions, though very slowly, and in some cases, trends are uncertain or indiscernible (Archer et al. 2009, Archer and Ojala 2016a, 2016b, 2016c)). This pattern would be expected to continue under Alternative A, but would likely improve more quickly under any of the plan revision alternatives where animal unit month stocking and/or allowable use levels are similar to or less than current stocking levels. Desired conditions, standards, and guidelines could be met under Alternatives D, E-Modified or E-Modified Departure, but the heavier stocking levels would likely require relatively more intensive management to achieve desired conditions and to meet standards and guidelines on an annual basis. Reduced impacts to riparian areas and aquatic habitats could be expected to occur under Alternatives E and F in the majority of watersheds on each forest due to presence of anadromous species and/or bull trout, and the reduced riparian utilization standards that would apply in those watersheds. Guidelines for riparian grazing and desired conditions for federally listed species are likely to result in intensified grazing management and faster improvement for federally listed species where watershed conditions are impaired in terms of riparian, aquatic habitat or water quality, per the Watershed Condition Framework analyses, once closer review are conducted as the plan is implemented and existing consultations expire.

Timber harvest can influence aquatic ecological condition via such activities as removal of trees in the riparian zone, removal of upslope trees, and associated understory or slash burning (Hicks et al. 1991). These activities can affect wood recruitment, stream temperatures, erosion potential, stream flow regime, and nutrient runoff, among others (Hicks et al. 1991). Effects of harvest are likely to be different at different scales. Hemstad and Newman (2006) found few effects of

harvest at the site or reach scale, but found that harvest 5 to 8 years earlier resulted in losses of habitat quality and species diversity at the scale of a stream segment (larger than a reach) or at the subwatershed level. Those losses were revealed in terms of increases in bank instability and fine sediment throughout the watershed and increased water temperatures and sediment problems throughout the channel segment. The cumulative effects of widespread harvest within a single drainage in a short period of time resulted in deterioration of the aquatic and riparian habitats, but evidence of effects lagged harvest by several years and different evidences of deterioration showed up at different spatial scales within the watershed.

To minimize risks of unintended effects, ground disturbance in riparian areas would be managed to achieve desired conditions for water quality and fish habitat through use of best management practices and watershed analyses. Watershed-specific objectives for riparian and aquatic habitats would be integrated with watershed-specific objectives for fuels and vegetation management at the project level. As required by PACFISH and INFISH standards and guidelines, as well as desired conditions and standards and guidelines in the 2008 Regional ARCS and the 2018 Blue Mountains ARCS, any treatments in riparian areas under any of the alternatives, would be required to be designed and implemented to move riparian management areas towards desired conditions, benefit habitat for aquatic species and contribute to recovery of federally listed aquatic species. Watershed analyses and integration of multiple objectives in project design is likely to contribute to restoration of natural watershed and hydrologic function and processes at the watershed scale over the long term.

Plan alternatives could have indirect effects on designated critical habitat since projects implemented under any of the alternatives would be required to move towards desired conditions for watershed function and maintain or improve species diversity and viability. Restoration actions, such as culvert replacement or floodplain restoration requiring in-channel or near-channel operation of heavy equipment, may affect individuals of listed species or designated critical habitats, or both, in the short term. The long-term effects would be expected to be beneficial in terms of habitat response in most cases.

Watershed restoration actions in priority watersheds would serve to recreate larger networks of connected high quality habitats within and between watersheds in each subbasin with identified key watersheds. Building these larger connected networks of good habitat would increase resiliency of listed species to both landscape scale and smaller disturbances by allowing listed and other species to relocate to better habitat when the habitat they are currently using is impacted by episodic natural disturbances. Watershed analyses and Endangered Species Act consultations would help to determine project-level tradeoffs in short-term effects to fish and habitats for the sake of long-term benefits of restored natural processes for projects implemented.

Other land management activities could result in short term effects to designated critical habitat or listed species, depending on project design and the frequency and intensity of the activity. Those activities would potentially include livestock grazing, construction of new roads, mining activity, and/or timber harvest within 300 feet of perennial or intermittent fish-bearing streams. Alternative D would experience the highest frequency and intensity of ground disturbing activities that could affect listed species and designated critical habitat over the life of the plan, based on objectives, desired conditions, standards, and guidelines for that alternative. The higher level of vegetation management objectives in Alternative D would require retaining higher amounts of system road than would be needed for implementation of the other alternatives and could require retaining key system roads in riparian management areas that would not need to be retained under alternatives with lower levels of vegetation management, particularly in dry forest

landscapes. The tradeoff is in achieving reductions in road effects in parts of the landscape where frequent reentries would not be needed for prescribed burning or other forest management activities to maintain desired forest vegetation conditions (Rieman et al. 2000).

Consultation would be undertaken with National Marine Fisheries Service and U.S. Fish and Wildlife Service based on effects of implementing actions for the selected alternative. Actions implemented under a new plan will be consulted at the project level or at program level for specific categories of activities. Modifications will be developed at project or program level if needed, to reduce risks to listed species and their designated critical habitats.

In summary, each of the plan revision alternatives may affect any or all of the listed species and/or their designated critical habitats, for the reasons given. A biological assessment for the preferred alternative has been developed in detail and serves as the basis for Endangered Species Act Section 7 Consultation on bull trout, Snake River Basin spring Chinook salmon, Middle Columbia River and Snake River Basin steelhead with U.S. Fish and Wildlife Service and National Marine Fisheries Service, respectively.

Environmental Consequences to Sensitive Species

Forest Service viability status and effects analyses for redband trout populations in the Harney-Malheur Lakes subbasin within the Malheur National Forest represent status and indirect effects to sensitive redband trout of the Malheur Lakes distinct population segment. Based on the redband protection scores presented in Table 261, standards and guidelines, desired conditions for Alternatives B, C, E, E-Modified, E-Modified Departure, and F are, in some cases, as strong as or stronger than those elements as they are contained in the 1990 plans, as amended by INFISH. For example, additional guidelines (standards in the case of Alternatives C and E-Modified) have been added to avoid the risk of grazing livestock trampling redds of listed species during spawning season before young fish have emerged from the gravels (MA 4B, GM-6S). Non-listed sensitive aquatic species that spawn in those streams during the same season as either spring and/or fall spawning listed species would likely accrue collateral direct benefits from this guideline.

Increased protections related to roads are reflected in standards and guidelines for Alternatives B, C, E, E-Modified, E-Modified Departure, and F that prohibit construction of new roads and trails in high elevation riparian areas. This requirement would be an added protection for sensitive westslope cutthroat trout and other species spawning in high elevation headwater streams.

Monitoring using protocols developed for the PACFISH-INFISH Biological Opinion Effectiveness Monitoring Program would likely remain in use in future years, and local monitoring would likely employ these same or similar protocols where additional, site-specific monitoring may be needed. These monitoring trend results are currently showing a slowly improving trend in riparian and aquatic habitat conditions across the Plan Area under the 1990 Forest Plans and those trends are expected to continue for all alternatives.

Management would potentially affect viability for sensitive species in the Tucannon, Umatilla and Walla Walla subbasins, particularly for the Margined sculpin. A narrow endemic Sensitive species, the Margined sculpin inhabits the Upper Tucannon, Walla Walla and Umatilla subbasin headwaters within the Umatilla National Forest, as well as the mainstem Tucannon River in state lands downstream of the national forest boundary. The known distribution ranges from medium rivers to moderate-elevation headwater tributaries in those systems.

Margined sculpin are a small-bodied freshwater resident species strongly associated with the streambed, as are bull trout, but are a spring-spawner similar to redband and steelhead. Fair to mostly good connectivity and condition ratings for redband and bull trout habitats in the Walla Walla and Tucannon subbasins suggest that the Margined sculpin is not trending towards listing within the Umatilla National Forest (see Table 253 and Table 259).

The Malheur National Forest is the only national forest where management would potentially affect viability for Harney Basin Duskysnail and the Great Basin (Malheur Lakes) distinct population segment of redband trout. Based on current knowledge of its distribution, surveys for presence of the Duskysnail would need to be done prior to development of any natural springs, and a site-specific assessment would ensure any populations located would be protected.

Effects of projects implemented under any of the alternatives would be expected to move towards desired conditions for watershed function, key watersheds, hydrologic connectivity, stream shade, water quality and riparian condition, as described in appendix A. Improvement of any of these factors would help to maintain and improve population viability for the sensitive species considered in this assessment.

Active restoration in priority watersheds would potentially have short-term effects for any alternative, but the magnitude of those effects at any point in time would likely be localized. Road decommissioning in riparian management areas, replacement of culverts for fish passage, and instream habitat restoration are all potential short-term effects that would result in long-term beneficial effects. These actions would be most likely to occur in key watersheds and would serve to recreate larger networks of connected high quality habitats within and between watersheds in each subbasin with identified key watersheds. Long-term effects would be expected to benefit all aquatic species present or potentially present within those project areas.

Best management practices would be applied to all ground disturbing projects to protect water quality and habitat for Sensitive aquatic species; however, research has shown best management practices to lose effectiveness the closer activities are to stream channels, to become less effective the steeper the ground is adjacent to the channel, and to be ineffective or to vary in effectiveness when riparian buffers are not in place (Rashin et al. 2006). Best management practices would be an added protection for bull trout and other listed species spawning in high elevation streams.

Rate of progress towards desired conditions through natural processes would vary by alternative, as indicated by differences in protection scores (see Table 252 through Table 263). In addition, no increases in road density would be allowed in key watersheds.

For Alternative A, all subwatersheds where listed fish species are present would remain key and priority subwatersheds respectively under the 1990 plans as amended by PACFISH or INFISH. A smaller set of key (including priority) subwatersheds would be implemented for any of the plan revision alternatives as discussed previously. For Alternatives B, E, E-Modified, E-Modified Departure and F, riparian management areas would provide the same or greater degrees of protection as currently provided in riparian habitat conservation areas within key and priority watersheds under PACFISH and INFISH (Alternative A), because the maximum riparian management area widths would apply in every subwatershed in each national forest. They would not be limited to key and priority watersheds with designated critical habitat or listed species, as now directed by INFISH and PACFISH for riparian habitat conservation areas for Alternative A. Practically speaking, the application of these maximum riparian management area widths for Alternatives B, E, E-Modified, E-Modified Departure, and F make no difference for the Umatilla National Forest. In the Umatilla National Forest, essentially every subwatershed contains

designated critical habitat for one or more listed species. The maximum riparian management area widths are already being applied throughout the Umatilla National Forest for this reason and would continue to be applied for Alternative A.

For the Malheur and Wallowa-Whitman National Forests, the application of these maximum riparian management area widths for Alternatives B, C, E, E-Modified, E-Modified Departure, and F would constitute an increase in acres incorporated in riparian management areas and miles of aquatic habitat receiving passive restoration benefits relative to the number of acres managed within riparian habitat conservation areas in Alternative A. The reason for the increase in riparian management area acreage for these two National Forests is that they have a substantial number of subwatersheds where only redband trout are present. As a result, these watersheds do not currently contain designated critical habitat for any listed species and therefore the maximum riparian habitat conservation area widths are not currently being applied and would not be applied under Alternative A.

The allocation to more acreage to riparian management areas for the Malheur National Forest for Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F relative to the amount of acres managed as riparian habitat conservation areas in Alternative A would potentially result in greater benefits from passive restoration to Great Basin redband trout and other freshwater species in the Oregon Closed Basins. The increase in riparian management area acres for these alternatives would be added in subwatersheds that do not contain designated critical habitat or listed species, i.e., in subwatersheds located within the Oregon Interior Basins within the Malheur National Forest in particular. Redband trout may also receive added benefits with respect to passive restoration from increased acreages in riparian management areas in subwatersheds upstream of Hells Canyon Dam on the Wallowa-Whitman National Forest and in the Crooked River subwatersheds management by the Malheur National Forest, where no listed species or designated critical habitats are present.

Research has shown that effective vegetated filter strips need to be at least 200 to 300 feet wide to effectively capture sediment mobilized by overland flow from outside the riparian management area. Rieman et al. (2001), in analyzing the most aggressive restoration alternative for the Interior Columbia Basin Ecosystem Management Project, determined that the habitat benefits provided during the first 10 years of implementation for restoration of forest vegetation under that alternative were lower than the benefits achieved through less aggressive restoration schedules. They noted that vulnerable aquatic species could be impacted in the short term in ways from which they could not easily recover, even if long-term benefits eventually became evident in later years. Alternative D and E-Modified Departure are the alternatives where that risk would most apply.

Alternatives B, C, E, E-Modified, E-Modified Departure and F provide for protections at least as strong as those provided by current management direction under Alternative A. Activities are currently permitted within riparian habitat conservation areas, so long as they do not retard habitat recovery through natural processes. Thus, the difference between Alternative D and Alternative A is a difference in level of risk of degradation that may occur once the streamside area identified for management for riparian and aquatic habitat values is narrowed. Protections of water quality, aquatic and riparian habitats would be lower for Alternative D when compared to Alternative A in terms of permitted activities and infrastructure near stream channels, and the narrow riparian management area widths associated with Alternative D would pose higher risks of unintended negative effects to aquatic species and habitats, and could interfere with restoration of natural hydrologic processes and watershed function.

The increased risks from activities with Alternative D would be associated with roads, livestock management, timber/fuels management, and mining, and would also be potentially associated with other infrastructure-related management activities. These activities potentially affect Sensitive or surrogate species and their habitat, and, by association, other aquatic sensitive species that are not yet Endangered Species Act listed. Such effects would likely be localized and would be unlikely to result in a trend toward listing for Great Basin redband trout, westslope cutthroat trout, margined sculpins or riverine mollusks. Project-level biological evaluations would assess effects to these species when activities occur in areas occupied by these localized species, and develop site-specific mitigations to reduce those risks if needed to avoid a trend towards federal listing.

Best management practices monitoring, aquatic surveys and continued monitoring of conditions and trends in aquatic and riparian habitat conditions are likely to identify any project-level situations detracting from achievement of desired condition. Use of best management practices monitoring is expected to facilitate implementation of proactive management changes quickly enough to maintain or restore timely progress towards desired conditions for riparian and aquatic habitats.

Both the 2008 and 2016 Regional Aquatic and Riparian Conservation Strategy and the 2005 Regional Aquatic Restoration Strategy recognized the need to strategically focus scarce restoration funds where they would contribute the most to recreating effective networks of connected watersheds and subwatersheds and high quality habitats across the Blue Mountains national forests. The intent behind targeting focus watersheds and priority subwatersheds for restoration was that they would provide the greatest benefits for recovery of listed species. The above sensitive species are each known present in at least some of the key subwatersheds within their range and are likely to benefit to some extent from active restoration in priority subwatersheds, depending on where work is done relative to the distribution of each species.

Sensitive Species Determinations

Malheur National Forest – All alternatives except D may impact individuals or habitat, but are not likely to result in a trend towards listing for the Malheur Lakes distinct population segment of redband trout or other sensitive fish and aquatic invertebrate species within the Malheur National Forest for reasons discussed above and in the surrogate species sections. Alternative D, due to the possibility that habitat recovery may not progress at acceptable rates of passive restoration and insufficient investments in active restoration may not occur, may result in a trend towards listing for redband trout in the Oregon Closed Basins, particularly the population in the Malheur Lakes subbasin.

None of the plan components completely addresses risks to potential habitat for the dusky snail with respect to spring development or water diversion out of a spring fed channel flow. However, site surveys and project-specific analyses would likely ensure any newly discovered populations are protected in ways that would avoid a trend towards Federal listing.

Umatilla National Forest – All alternatives may impact individuals or habitat, but are not likely to result in a trend towards listing for margined sculpin or other sensitive fish and aquatic invertebrate species within the Umatilla National Forest for reasons discussed above and in the surrogate species sections.

Wallowa-Whitman National Forest – All alternatives may impact individuals or habitat, but are not likely to result in a trend towards listing for sensitive fish and aquatic invertebrate species

within the Wallowa-Whitman National Forest for reasons discussed above and in the surrogate species sections.

Environmental Consequences to Management Indicator Species

Only the no action alternative (Alternative A) would be evaluated in terms of the management indicator species listed in the 1990 Forest Plans. No management indicator species were selected for evaluation for the plan revision alternatives, based on factors discussed in the Affected Environment section and expanded upon here. Limiting aquatic management indicator species to Alternative A reflects the historic and ongoing cumulative effects to populations and fish habitats in lands in other ownerships within the subbasins occupied by each management indicator species as represented by surrogate species that served as management indicator species in the 1990 Forest Plans. Further detail is provided in the Analysis of the Management Situation.

The surrogate species concept used for Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F would use habitat condition and trends as a proxy to monitoring species diversity and viability on National Forest System lands. Population viability status for federally listed species in each subbasin would be tracked at the all-lands scale by U.S. Fish and Wildlife Service and National Marine Fisheries Service and would be based on integration of multiple criteria for each population. Viability for species not tracked by U.S. Fish and Wildlife Service and National Marine Fisheries Service would likely be tracked by state agencies responsible for fish and wildlife resources in their respective states, to the extent that state resources are available.

Within the limits of the Forest Service authority and landbase, Alternative A would not likely result in a loss of viability for redband trout or other management indicator species. Riparian and aquatic habitat conditions are beginning to demonstrate statistically supportable trends in improvement resulting from implementation of PACFISH and INFISH standards, guides, goals and objectives, and key and priority watersheds. Implementation of PACFISH and INFISH standards, guides, goals and objectives would continue under Alternative A. Active restoration is currently ongoing to restore habitat quality and quantity in select subwatersheds and is expected to continue to the extent funding and staffing are available. Those trends would likely continue with continued implementation of PACFISH and INFISH.

Monitoring conducted under the PACFISH-INFISH Biological Opinion effectiveness monitoring program would continue. Additional analysis over time would serve to strengthen these conclusions or reduce statistical “noise” enough to detect whether the apparent trends are genuine and continuing. PACFISH-INFISH Biological Opinion effectiveness monitoring may provide the means to project rates of recovery of aquatic habitats across the landscape as enough data accumulates to provide stronger statistical assessments of trends and rates of recovery in riparian and aquatic habitat conditions.

Malheur National Forest

Westslope cutthroat trout are a management indicator species for the Malheur National Forest for the 1990 Forest Plan, as amended by PACFISH and INFISH (Alternative A), and viability for the species needs to be considered at the scale of the Malheur National Forest for Alternative A. Outcomes for redband trout as a surrogate species are considered to represent outcomes for westslope cutthroat trout and other freshwater trout, aside from bull trout, but effects to westslope cutthroat are represented specifically by effects to redband trout in the Upper John Day subbasin, since westslope cutthroat do not occur elsewhere within the Malheur National Forest. Viability

for redband trout in the Upper John Day subbasin is good, therefore viability for westslope cutthroat trout is currently considered good within the Malheur National Forest under Alternative A. The Malheur National Forest's contribution to viability of westslope cutthroat trout is moderate, as the proportion of spawning and rearing habitat within that national forest is nearly 70 percent, and much of that habitat is located within wilderness areas.

Effects to viability of bull trout for Alternative A are discussed and disclosed in the "Species Viability" section. An assessment of short- and long-term implications to viability for each alternative is disclosed in the "Threatened and Endangered Species" discussion. Loss of viability for species or component populations in National Forest System lands would not be expected if current management direction (Alternative A) were to be continued under PACFISH and INFISH direction, given current improving trends for riparian and aquatic habitat conditions at the scale of the Plan Area.

Umatilla National Forest

Redband trout and steelhead are management indicator species for the Umatilla National Forest for the 1990 Forest Plan, as amended by PACFISH (Alternative A). Viability for both species needs to be considered at the scale of the Umatilla National Forest for Alternative A.

Effects to viability of steelhead for Alternative A are discussed and disclosed in Effects to Viability in the "Surrogate Species" section. Effects to viability of redband for Alternative A are discussed and disclosed in the "Environmental Consequences to Surrogate Species Viability" section. An assessment of short and long-term implications of alternatives to steelhead viability is disclosed in the "Threatened and Endangered Species" discussion above.

Viability for redband trout and steelhead in Umatilla National Forest subbasins currently is fair or good, and the loss of viability for species or component populations at in National Forest System lands would not be expected if current management direction were to be continued under PACFISH and INFISH direction, given current improving trends for riparian and aquatic habitat conditions at the scale of the Plan Area.

Wallowa-Whitman National Forest

Because westslope cutthroat trout are a management indicator species for the Wallowa-Whitman National Forest for the 1990 Forest Plan, viability for the species needs to be considered at the scale of the national forest for Alternative A. Outcomes for redband trout as a surrogate species are considered to represent outcomes for westslope cutthroat trout and other freshwater trout, aside from bull trout. Steelhead and bull trout are also management indicator species for the Wallowa-Whitman National Forest for the 1990 Forest Plan, and viability for both species needs to be considered at the national forest scale for Alternative A.

Effects to viability of steelhead and redband trout with Alternative A are discussed and disclosed in "Environmental Consequences to Surrogate Species Viability" section. Assessments of short and long-term implications of alternatives to steelhead viability are disclosed in the "Threatened and Endangered Species" discussion.

Viability for redband trout, westslope cutthroat trout, and steelhead in subbasins of the Wallowa-Whitman National Forest currently is fair or good for the 1990 Forest Plan as amended by PACFISH and INFISH (Alternative A) and loss of viability for species or component populations on National Forest System lands would not be expected if current management direction were to

be continued under PACFISH and INFISH direction, given current improving trends for riparian and aquatic habitat conditions at the scale of the Plan Area.

Environmental Consequences to Magnuson-Stevens Act Species (Pacific Salmon)

A determination of “may affect” under the Magnuson-Stevens Act is made when a determination of “no effect” cannot be made with certainty. Since plan components and other plan direction, either together or separately, may indirectly affect Endangered Species Act-listed Snake River Basin Chinook salmon and may affect other non-listed spring Chinook salmon stocks wherever they occur for reasons similar to those given for listed salmon species, a finding of “may affect” under the Magnuson Stevens Act would apply to each plan action alternative for each national forest where Snake River Basin or Middle Columbia River spring Chinook salmon are present. The “may affect” determination applies to spring Chinook salmon in either evolutionarily significant unit, excluding only the John Day and Walla Walla subbasins, and a “no effect” determination would apply to Snake River Basin fall Chinook salmon, as well as to Snake River Basin sockeye.

Pursuant to requirements of the Magnuson-Stevens Act that include an assessment of effects, consultation would be conducted with National Marine Fisheries Service concurrently with Endangered Species Act Section 7 Consultations to ensure protection of all Pacific Ocean salmon species within the Blue Mountains national forests.

Cumulative Effects

Cooperative fish habitat and native fish population restoration work is ongoing between Forest Service ranger districts, Tribes, and local stakeholders represented by soil and water conservation districts, watershed councils and nongovernmental organizations. Cooperation across administrative boundaries is increasingly important in efforts to meet increasing demands and competing values for natural resources placed by a growing human population with ultimate impacts on fisheries resources. This cumulative effects analysis considers actions in lands of all ownerships within the full subbasins in which National Forest System lands are found over the next 10 to 20 years, unless otherwise specified.

Cumulative Effects on Species Viability

The biology and legal status of anadromous steelhead demonstrates that steelhead populations are heavily influenced by many factors outside and downstream of National Forest System lands. These factors include competition and interbreeding with hatchery stocks; tribal, recreational and commercial harvest; habitat conditions including water quality in the migratory river corridors and yearly and decadal changes in the ocean rearing environment; and, impacts of passing through multiple main-stem hydropower dam operations during both emigration downriver to the ocean as subadults and as adults returning upriver to spawn in their natal streams. These population-level and evolutionarily significant unit and distinct population segment-level impacts are described in multiple documents including the Middle Columbia River Steelhead Recovery (NMFS 2009), the Columbia River Bull Trout Recovery Plan (USFWS 2015), the Snake River Basin Salmon and Steelhead Recovery Plan (NMFS 2016), and subbasin plans for the Middle Columbia River and Lower Snake River subbasins associated with the Blue Mountains National Forest Plan Area (NWPCC 2004 online).

Current habitat conditions and connectivity at the subbasin scale were considered in lands of all ownership for each component population of the selected surrogate species using the Blue Mountains Sustainability Model for Plan Revision, which followed Reiss et al (2008) for

methods. Those conditions influence freshwater species as well as the anadromous species, since freshwater populations move seasonally within the drainage network and larger fluvial individuals of freshwater species are known to winter in the larger, lower elevation portions of the stream network downstream of National Forest System lands.

Current connectivity and habitat conditions in National Forest System lands are the result of past natural disturbances, particularly floods and wildfire, and past land management activities including grazing, mining, timber harvest and road construction, in particular. Those disturbances, along with fires and floods, have also taken place within private and state lands, including the small, private-ownership inholdings that checkerboard within the forest boundaries, and the habitat condition scores in each subbasin reflect those past effects. Habitat connectivity has been disrupted by culverts, dams, water withdrawals for irrigation. More than 3,700 miles of fish habitat for one or more surrogate species within National Forest System lands are blocked, or seasonally blocked, by National Forest System road culverts. Existing loss of connectivity within subbasins appears to a primary impact to current viability for any of the species, but particularly for bull trout. Timber harvest, grazing and mining have contributed to degradation of stream channels and floodplains, resulting in less water storage and release for instream flows during the summer season.

Seasonal barriers created by loss of stream flow and/or thermal barriers created by water temperatures can exceed species tolerances. Impassible dams and diversions disrupt habitat and population connectivity downstream of national forest boundaries and between subbasins, and other diversions and water withdrawals have partially disrupted connectivity within National Forest System lands in some subbasins. Many of those effects would continue for the foreseeable future. Grazing and timber production are likely to continue on private lands, and small-scale mining operations are likely to continue on private lands in places where they already occur.

As in the case of anadromous species, the quality, size, and accessibility of spawning and rearing habitat in National Forest System lands play but a partial role in terms of ensuring long-term viability of bull trout as a species. As Nelson et al. (2002) discovered, even where other associated salmonids, such as redband trout and westslope cutthroat trout, retained fluvial life histories, bull trout populations in the same drainage may exhibit only the headwater-resident life history, even where the fluvial life history may have been present in the drainage in times past. Various theories for this divergence in life history capabilities between species in the same drainage were posited, but further research on loss and recovery of the expression of the fluvial bull trout life history would be needed to help answer the uncertainties that remain.

A study of long-term (10-plus years) effects of fire was conducted by Rosenberger et al. (2011). Their findings suggest that general characteristics of stream ecosystems may recover more quickly than the underlying processes from which they are derived. They concluded that detecting more subtle long-term ecosystem impacts from wildfire disturbance and correlating condition of fish populations may require more in depth analyses. This is particularly important considering increased water temperatures, wildfire occurrence, and the accompanying shifts in ecosystem function that could be exacerbated by ongoing climate warming.

Recovery plans are in place for Middle Columbia River steelhead, as well as Snake River Basin salmon and steelhead (NMFS 2009, NMFS 2016). Private stakeholder and state agencies in Oregon and Washington within the range of Middle Columbia River steelhead are implementing recovery actions in subbasins identified in the recovery plan, and are contributing to and complementing Forest Service restoration efforts in these subbasins. The Southeast Washington

Recovery Plan for listed Snake River steelhead, sockeye, fall Chinook salmon and spring Chinook salmon (NMFS 2005) is being implemented by private stakeholders and Washington state agencies. The final Snake River Basin Salmon and Steelhead Recovery Plan is being implemented throughout the Snake River Basin portions of the Plan Area, downstream of Hells Canyon dam, including within the Hells Canyon National Recreation Area which would continue to be managed by the Wallowa-Whitman National Forest under the 1990 Plan as amended by PACFISH and INFISH, guided by the 2003 Comprehensive Management Plan. Bull trout receive recovery benefits from actions taken to restore salmon and steelhead populations where their habitats coincide within the implementation of restoration activities. Redband trout benefit from actions in watersheds shared with listed species, as well as actions undertaken with partners and across boundaries in watersheds with split ownerships, in the Oregon Closed Basins as well as in watersheds within the Middle Columbia and Snake River basins.

Operation of the many dams on the main-stem Columbia and Snake rivers would continue to affect listed steelhead and salmon species within the cumulative effects analysis area, as would recreational and tribal harvest. State and tribal hatcheries for steelhead and salmon would continue to provide hatchery fish for harvest as mitigation for loss of wild fish due to the dams, but hatchery management at individual hatcheries is shifting to support recovery of wild anadromous stocks. Recreational fishing would continue to affect bull trout to an unknown degree. In subbasins where National Forest System lands provide no spawning and rearing habitat, cumulative effects of Forest Service management on species viability on National Forest System lands are minor at best.

So far as plan revision alternatives would contribute to cumulative effects to viability of aquatic surrogate species, Alternatives B, C, E, E-Modified, E-Modified Departure, and F would reduce effects to these species from past and present management in National Forest System lands by restoring a wide assortment of priority watersheds and other key watersheds, along with a variable set of additional lower-quality watersheds. Alternative A would maintain or continue to reduce effects at rates that may be slower or faster than would occur under other alternatives, depending on the species, the number and location of priority subwatersheds restored under each alternative, and the degree of riparian and aquatic habitat protection afforded by each alternative, both short term and long term. Alternative D may create greater cumulative effects than the other alternatives, but the balance of risks from combined short-term effects of landscape protections and active restoration in priority watersheds relative to long-term benefits of landscape protection and active restoration in priority watersheds is unknown, since the same desired conditions apply to all alternatives.

Cumulative Effects to Surrogate Species

All alternatives would contribute to restoring or maintaining sustainable populations of surrogate species and their habitats through management of riparian management areas to meet desired conditions and protect listed species and their designated critical habitats wherever they occur. Active restoration for listed species and critical habitats would continue to improve key watersheds and subbasins for surrogate species leveraging restoration efforts on other land ownerships wherever interests overlap across watershed boundaries. Non-listed redband trout and Chinook salmon would receive cumulative positive effects from actions taken to restore bull trout, steelhead and listed salmon in the Snake River and Middle Columbia River basins.

There would be positive effects from alternative-dependent mixes of passive and active restoration that benefit multiple surrogate species present in key watersheds under all alternatives.

Passive and active restoration combined across each national forest would complement restoration efforts undertaken by stakeholders including Tribes, local nongovernment organizations and state agencies to restore listed species and habitats in those watersheds and would cumulatively contribute to restoration of entire watersheds and subbasins over time.

The biology and legal status of steelhead and spring Chinook salmon, particularly in the Snake River and Middle Columbia River basins, demonstrate that anadromous populations are heavily influenced by many factors outside and downstream of National Forest System lands. Competition and interbreeding with hatchery stocks; tribal, recreational and commercial fish harvest; habitat conditions including water quality in the migratory river corridors and yearly and decadal changes in the ocean rearing environment; and impacts of passing through multiple main-stem hydropower dam operations during both emigration downriver to the ocean as subadults and as adults returning upriver to spawn in their natal streams influence surrogate species viability. These population and evolutionarily significant units/distinct population segment-level cumulative impacts from historic and ongoing factors outside the scope of Forest Service management authority are described in multiple documents, including Federal Registers in which steelhead and spring Chinook salmon were listed as threatened species, the Middle Columbia River Steelhead Recovery Plan (NMFS 2009), and subbasin plans for the Middle Columbia River and Lower Snake River subbasins (NWPCC 2004). Federal Registers that listed Columbia River Basin bull trout and their designated critical habitats describe similar cumulative impacts to bull trout in subbasins where bull trout occur. Subbasin plans describe similar cumulative impacts and threats to redband populations where redband populations occur.

Highly effective all-lands restoration efforts are ongoing in multiple watersheds and subbasins, which leverage restoration efforts in portions of each National Forest in the Plan Area. Examples include the southeast Washington's Snake River Salmon Recovery Board, which includes representatives from 2 area tribes, 5 counties, multiple state agencies, private landowners, and multiple Federal agencies including the Forest Service. Funding decisions by the Board ensure that restoration funds go to well-thought out projects through a collaborative prioritization process that implements restoration projects targeting restoration actions identified in Recovery Plans for bull trout and anadromous species in southeast Washington in both the mid-Columbia and Snake River basins, leveraging forest service restoration efforts on National Forest System lands. Similar all-lands, multi-organizational efforts are developing in portions of the Umatilla and Walla Walla subbasins, as well as in all of the John Day subbasins, which are working to implement the Oregon portions of the Middle Columbia River steelhead Recovery Plan. The Grande Ronde Model watershed group continues to implement actions detailed in the Oregon Snake River Basin recovery plan for anadromous species and the bull trout Recovery Plan.

Cumulative Effects to Threatened and Endangered Species

Restoration actions are ongoing on private, state and tribal lands in subbasins supporting listed steelhead, bull trout and Chinook salmon populations within the cumulative effects analysis area, including changes in hydropower operations, hatchery operations, harvest management by the states and habitat improvement activities. Those actions are guided by individual subbasin plans developed for the Northwest Power Planning Council and by Recovery Plans for listed bull trout and anadromous species. Restoration actions are likely to continue for the foreseeable future as a continuation of recovery plan implementation through State, Federal, and private partnerships and other collaborative efforts. In aggregate, those restoration actions are expected to support and promote recovery of each federally listed species and their designated critical habitats, in accordance with their respective recovery plans.

Cumulative Effects to Sensitive Species

Cumulative effects of alternatives to redband trout and steelhead were discussed in the "Surrogate Species" section. Redband and bull trout serve as surrogate species surrogates for westslope cutthroat trout and margined sculpin, and cumulative effects of the alternatives on these species constitute the cumulative effects analyses for redband trout, westslope cutthroat trout and margined sculpin as sensitive species. There would be no cumulative trends towards Federal listing for these species from management actions for any of the alternatives.

Cumulative Effects to Management Indicator Species

Cumulative effects to redband trout, steelhead, bull trout, westslope cutthroat trout and other non-anadromous trout were discussed as surrogate species or are represented by cumulative effects to surrogate species. No cumulative effects to these management indicator species from management actions are expected to occur for Alternatives B, C, D, E, E-Modified, E-Modified Departure, or F. Net reductions in cumulative effects are likely to occur for Alternative A, given current indications of improving trends in aquatic habitat and riparian conditions across the Blue Mountains national forests' Plan Area, and improving trends in population viability (all-lands) scale in many subbasins and stable populations in other subbasins, at the all-lands scale. Those improving trends are expected to continue at nearly natural rates for Alternative A, which would continue current management under PACFISH and INFISH direction.

Climate Change Implications for Species Diversity and Viability

McElhany et al. (2000), noted "…processes contributing to extinction risk (catastrophes and large scale environmental variation) …need to be assessed at the larger temporal and spatial scales represented by ESUs or other entire collections of populations" (i.e., scales larger than the Blue Mountains Plan Area). More recently, climate change effects can be projected at the scale of the Plan Area and even by subbasin (Haak 2010, Hamlet et al. 2010. Some subbasins and species would be affected more quickly than others.

Fall spawning species, such as salmon and bull trout, whose eggs overwinter in streambed gravels, are likely to be impacted by increased winter flooding and greater movement of streambed gravels and cobbles during winter rain-on-snow events. Steelhead and redband trout are spring spawners; their spawning activity typically occurs as winter and spring flood flows are declining. Their eggs are less likely to be damaged than the eggs of fall-spawning salmon and bull trout. Some subbasins that are currently snow-dominated (spring snowmelt) systems, are expected to shift to transitory-snow (winter rain-on-snow) dominated systems, as climate change progresses. These would be the subbasins where spring Chinook salmon and bull trout spawning habitats would be most at risk. Other subbasins may experience limited change in timing of runoff and fish populations would be less affected by shifts in timing of runoff. Other subbasins may shift to winter rain-dominated systems from their current transitory-snow dominated regimes.

The science panel that reviewed the Aquatic and Riparian Conservation Strategy made the general observation that:

> Climate-related factors, such as temperature and streamflow, could affect habitat in different ways and at different scales depending on local site characteristics. Therefore, a diversity of conditions is needed for population stability (Crozier and Zabel 2006).

Effects of ongoing climate change on riparian and aquatic habitats and Threatened, endangered, sensitive and other aquatic species could be reduced by active habitat restoration objectives

described in Appendix A, which incorporate many possible mitigation actions listed in Isaak et al. (2017). Improvements in fish passage would enable fish to recolonize drainages impacted by uncharacteristically severe fires. Redband trout and bull trout have been shown to recolonize severely burned drainages within two years, provided the drainages were physically accessible (i.e., no culvert barriers, and provided that other fish in unburned areas, particularly migratory adults, were close enough to discover and move back into the recently burned habitat (Rieman et al. 1997).

With anticipated effects of climate change during the next 20 to 40 years, increased winter and early spring flooding effects on fall spawning species, such as Chinook salmon and bull trout, are likely to be exacerbated where streams are deficit of large wood and where large wood inputs are below natural rates of recruitment. Research has shown that flooding has limited impacts on survival of redds and fry when sufficient large wood is present in the channel to mediate flow velocities and create naturally sheltered areas of slower water that act as refugia for older juveniles. Flooding would also have less impact where fish are able to move freely through the system due to passage barriers having been removed.

Interactions between restoration activities and natural disturbances would influence resiliency of fish habitat and community diversity in different ways that cannot be known fully at this time. For example, fish are more likely to be resilient to a stand-replacing fire and/or atypical flooding if fish passage to adjoining drainages is restored prior to the disturbance, thereby providing timely access to alternative habitat from while habitat recovers in the watersheds affected by the disturbance.

In subwatersheds where barriers have not yet been removed, fish habitat may be more resilient to fire if forest vegetation structure and composition, particularly in subwatersheds dominated by dry forest, are in a condition that would enable habitat to maintain or improve in the presence of frequent low intensity fire, high road density and frequent stand entries for mechanical fuels management. In subwatersheds and larger drainage networks (5th and 4th hydrologic unit code watersheds) dominated by mixed severity or stand-replacing fire regimes, fish are more likely to be resilient to climate change where restoration of instream large wood, habitat complexity, restored fish passage and "storm-proofed" road systems contribute to resiliency to flooding and reduced summer stream flows. . Storm-proofing can entail any of an assortment of road treatments designed to reduce vulnerability of existing open roads to washout from storm events, at stream crossings which may or may not be fish passage barriers, and may not be a priority for culvert replacement but still need reduced vulnerability to storm high flows. Examples of stormproofing treatments may include adding ditch relief culverts and water bars appropriately spaced along the roadway to reduce ditchline erosion, or adding rolling dips in roads immediately upstream or downstream of stream crossings, (dips hardened with coarse rubble from rock pits), which are designed to allow the road to be overtopped during storm events while reducing stream impacts from road washouts in the event that a culvert becomes blocked by debris or is undersized relative to an abnormally large storm event. Decisions on appropriate stormproofing design are made at project-scale. As Rieman et al. (2000) noted, every subbasin is different due to different climatic characteristics and the risks to fish and habitat from management impacts including retention and maintenance of existing road networks, versus impacts of wildfire, flood or drought exacerbated by climate change, may balance out in most of the Blue Mountains province. Investments in restoration of watershed function, aquatic habitat restoration and improved fish passage through culverts at road crossings, to the extent projected in Appendix A objectives under each alternative, would help to offset the impacts of natural disturbance

processes, particularly where dry forest vegetation has not yet been restored, grazing continues and where roaded access will still be needed.

Most researchers expect bull trout to be the least resilient to climate change of any of the surrogate species, in that they are likely heavily impacted by warmer waters which would constrict their habitat by warmer water encroaching further upstream, and further constricted by greater declines in stream flow on the upper colder ends of their habitat high in the watersheds due to earlier loss of snowpack. The Blue Mountains Climate Vulnerability Assessment for bull trout found that bull trout will be affected in the Blue Mountains as a consequence of changes in stream flow and water temperature (Isaak et al 2017, Clifton et al 2017). Lack of connectivity within and between subbasins may be more impactive to bull trout in the Blue Mountains than to the other species.

Bull trout, with their dependence on cold water, are expected to be severely affected; losses of habitat in the Columbia River Basin are estimated at 22 to 92 percent (ISAB 2007, Hixon et al. 2010). The practical implication is that some sensitive fish populations are likely to "blink out" or become isolated." Although the temporary blinking out of local populations is a natural that bull trout are adapted to, given their highly stochastic natural environments, the species is currently struggling to maintain viability in the face of existing core population numbers, loss of migratory life histories and loss of physical connectivity within and between core populations. Most core populations within the Plan Area are not able to easily accommodate additional "blinking out" given existing challenges to which they are not well adapted, given their current status (USFWS 2008, 2015), especially for those population which are already highly fragmented or very low in population numbers. The chronic threats posed by climate change would only exacerbate the challenges to recovery those populations already face. The Bull Trout Recovery Plan (USFWS 2015) has acknowledged that though desirable, recovery is unlikely to be achievable for all populations. They have set recovery goals for various populations of the species accordingly.

Fall-spawning spring Chinook salmon may be impacted by drought and high water temperatures more than bull trout, steelhead or redband, due to large body size and more of their habitat being located within larger streams and rivers in warmer lower elevation portions in Plan Area subbasins. Elevated water temperatures are expected to contract spawning reaches on the lower boundary of those reaches, while they may be unable to access upper portions of current habitat where lower snowpacks reduce base flows. Fall-spawning bull trout will likely see their year-round spawning and rearing habitats shrink as well, particularly on the lower end of the current range as water temperatures increase, and migration corridors may become inhospitable earlier in the spring, triggering upstream movement from wintering areas more quickly as spring runoff levels drop. Bull trout may find their habitat shrinking on the upper end of current use areas. In some stream reaches, riffles will become shallower and perhaps intermittent (Sando and Blasch 2015). This may result in disconnected stream reaches, isolated pools, overcrowding of fish for redband and steelhead especially (Ramsey, personal observation), increased competition for food and cover, and greater vulnerability to predators in remaining deep water habitat. Bull trout are less likely to experience overcrowding than redband or steelhead, as their natural behavior as juveniles is to seek visual isolation from one another, triggering downstream movement as they become larger and competition for food and space increase in headwater habitats. Juvenile bull trout may be less vulnerable than juvenile spring Chinook salmon, to invasive warm-water species such as smallmouth that are slowly expanding their range upstream in the North Fork John Day River (Lawrence et al. 2012, 2014), in that bull trout naturally hold near the streambed and have a high affinity for streams with high amounts of large wood that provide shelter from predators as well as from high stream flows.

Across the Plan Area as a whole, steelhead and redband are likely to be the most resilient of any of the surrogate species to effects of climate change, as they are the most widespread species with the widest range of habitat available, not all of which would likely be impacted simultaneously. Good connectivity within and between subbasins in terms of fish passage would enable juveniles and adults to move freely through the system to access cooler tributaries during summer heat, and to access slower side channels during floods. Steelhead, Chinook salmon, and bull trout have all been found to recolonize burned drainages within two years post fire and flooding, where they had access to move back into the watershed (Howell 2006, Rieman et al. 1997).

While there would be elevated risks to fish habitat that would likely vary by subbasin and therefore by species, not all of the anticipated trends would necessarily be harmful to aquatic habitats. A distinguished panel of scientists who reviewed the scientific basis for the 2008 Regional Aquatic and Riparian Conservation Strategy noted that climate change scenarios include an increase in large flood events, wildfires, and pathogen outbreaks. Haak et al. (2010) assessed the probability and likely magnitude of such effects within Plan Area subbasins over the next 50 years. The science panel reviewing the Aquatic and Riparian Conservation Strategy noted that these trends have some potential to improve habitat complexity in some areas as a result of floodplain reconnection and large wood recruitment.

Isaak et al (2017) concluded that when warming stream temperatures are considered in the absence of confounding or additive impacts, isotherms (thermal boundaries) are shifting slowly enough that many populations can be expected to shift with them so long as they are not inhibited by barriers, and in some cases, unsuitably cold habitats may exist further upstream and become sufficiently warm enough to offset losses at lower habitat margins where temperatures become too warm (Isaak et al. 2017, Al-Chokhachy et al. 2013). Moreover, although stream temperatures impacted by a warming climate will further isolate populations in headwaters, many species that inhabit mountain streams are already adapted to an insular existence and could continue to persist for long periods" (Isaak et al 2016), based on observations by Whitely et al. (2010). However, climate change stressors pose increased risks to such isolated populations (Haak et al 2010).

Mote (2003) stated that the extent to which restoration of stream habitat and altered dam operations would contribute to restoration of surrogate species and sensitive species, or the extent to which such actions would increase species resilience to climatic stresses, is an unknown. He stated his belief that it is impossible to say broadly (let alone for specific stocks) how those changes would compare with other environmental changes salmon have faced and would face in future. Steelhead are likely to experience challenges similar to those faced by salmon of similar ages, but due to seasonal differences in timing of migratory movement, spawning and egg residence periods in natal gravels relative to stream flows and water temperatures, the two species are likely to experience climate change in somewhat different ways.

With a warming climate, increased frequency of winter rains and an earlier snowmelt, "a higher frequency of severe floods would probably result in increased egg mortality due to gravel scour. Winter snowpacks would likely retreat and run off earlier in the spring (Mote et al. 2003a and 2003b), potentially impacting species whose migration to the ocean is timed to coincide with plankton blooms (Pearcy 1997). Summer base flows would probably be lower and the network of perennially flowing streams in a drainage system is likely to shrink during the summer dry period, forcing fish into smaller wetted channels and less diverse habitats (Battin et al. 2006). Warmer water temperatures would increase physiological stresses and lower growth rates. Summer peak temperatures may approach or exceed lethal levels for salmon and trout (Crozier and Zabel 2006,

Crozier et al. 2008). Higher temperatures would also favor species that are better adapted to warmer water, including potential predators and competitors (Reeves et al. 1987).

Climate change would likely force shifts in the distribution of fish populations affecting their ability to cope with natural disturbances, particularly drought (Battin et al. 2006). Streams located high in watersheds that historically provided some of the best habitat may no longer be accessible to migratory fishes if snowpack is reduced, thus limiting available rearing areas and access to thermal refugia in summer. Even moderate climate induced changes may significantly increase the risk of extirpating local populations of Chinook salmon (Crozier et al. 2008). Climate related factors, such as temperature and streamflow, could affect habitat in different ways and at different scales depending on local site characteristics. Therefore, a diversity of conditions is needed for population stability (Crozier and Zabel 2006).

"Existing well connected, high elevation habitats on public lands would be important to supporting salmon survival and recovery as the climate continues to warm (Martin and Glick 2008). As stated in both the 2008 and 2016 Regional Aquatic and Riparian Conservation Strategies:

> Maintaining and restoring these areas is a fundamental purpose for establishment of key watersheds. Active restoration actions would achieve objectives that would increase resiliency of aquatic habitat and populations to climate change, by reducing flood peaks by enhancing floodplain connectivity and disconnecting roads from streams, reconnecting isolated habitats by removing or replacing culverts, managing riparian forests to provide shade and other functions, and improving watersheds where aquatic habitats and water quality have been degraded. Actual impacts to aquatic ecosystems would be highly dependent on the degree to which these adaptation actions are implemented now and in the future.

Without these types of restoration actions the 2008 and 2016 Regional Aquatic and Riparian Conservation Strategies postulated that aquatic habitats and species are likely to become increasingly isolated, simplified, and less likely to recover after significant disturbance events. The Blue Mountains Climate Change Vulnerability Assessment continues to support this statement, given current conditions and projected conditions in the absence of such restoration actions (Isaak et al. 2017)

At a smaller scale, warmer stream temperatures associated with climate change are likely to exacerbate the extent and frequency of lethal temperatures in reaches occupied during low flow. Nonanadromous salmonids have been shown to move extensively within the stream network during periods in spring and fall when flows are either rising or falling, and tend to become sedentary during summer months when spring flows drop (Mellina et al. 2005), which puts them at risk from lethal temperatures they are not wired to escape. However, such extinctions would be dispersed, and freshwater trout move enough in cool seasons to keep populations connected. That population interconnectivity may contribute to long-term viability of local populations even for freshwater species, where that connectivity between populations exists or where it can be restored.

Two foundational assumptions for this analysis have been: (1) species that inhabit an aquatic ecosystem should benefit when it is functioning properly or when it is improving; and should be negatively impacted if aquatic habitats are degraded or in a downward trend; and (2) the most immediate potential for irreversible and irretrievable commitments of aquatic resources, are associated with threatened and sensitive aquatic species. Land management can positively or negatively affect aquatic resources. The magnitude of effect commonly relates to the scope (size

of area) and intensity of an action; its proximity to aquatic resources, the type of activity and the effectiveness of mitigation standards applied.

Collectively, the ARCS components are designed to maintain and improve watershed, riparian and aquatic habitat conditions, fish populations, and habitat connectivity, particularly within the key watersheds. As restoration is implemented across the Blue Mountains national forests, projects should slowly implement the Blues Vulnerability Assessment recommendations and create a network of properly functioning watersheds that are more resilient to withstanding some climate change effects and that are better able support to a variety of aquatic species and other riparian-dependent resources on National Forest System lands.

PACFISH and INFISH did not include active restoration as an essential element of those conservation strategies, whereas both the 2008 and 2016 Regional ARCS and the 2018 Blue Mountains ARCS do. All versions of the ARCS, Regional and Blue Mountains versions, as variously represented in the plan revision alternatives, promote varying degrees of resilience to effects of climate change through ARCS elements and plan components including riparian management areas, desired conditions, standards and guidelines, active restoration objectives, and key watersheds. Investments in active restoration under the plan revision alternatives are expected to increase resiliency of aquatic ecosystems to climate change and its derivative effects by: moderating stream temperatures by increasing stream shade, improving floodplain water storage and release to maintain base flows longer through the summer and fall, improving fish passage through culvert upgrades, improving habitat quality and connectivity for aquatic species, enabling them to move to more hospitable habitats from less hospitable habitats by managing riparian management areas and other portions of the watershed for desired conditions that restore hydrologic functions and processes together with federally listed species and their habitats.

Alternatives C, E, E-Modified, E-Modified Departure, and F include the greatest amount of acreage in riparian management areas, and due to associated desired conditions, management area suitable uses and standards and guidelines, these alternatives carry the lowest risk from detrimental management impacts, and may provide more opportunities for riparian habitat protection than other alternatives. Alternatives E-Modified and E-Modified Departure contain additional desired conditions for federally listed species, and additional Standards and Guidelines for key watersheds, all of which are likely to promote greater resiliency to effects of climate change for both listed and nonlisted aquatic species. Alternative D has the lowest number of miles of aquatic habitat restored, the narrowest riparian management areas, fewest acres of riparian restoration, and the least reduction in hydrologic connectivity of roads, and thus would have the lowest potential for maintaining aquatic habitat resiliency and habitat network connectivity in the face of climate change.

Alternative C would have the greatest number of miles of riparian restoration and stream channel enhancements, and the greatest reduction in hydrologic connectivity of roads, thus providing the greatest potential for maintaining aquatic habitat resiliency and network connectivity that would enable fish to relocate to the most suitable habitats seasonally, and would maintain habitable stream temperatures for aquatic species as air temperature rises. Alternatives E-Modified and E-Modified Departure, under the 2018 Blue Mountains ARCS contain additional desired conditions for federally listed species together with strengthened standards and guidelines for grazing and key watersheds in particular, which are likely to promote greater resilience and resistance to climate change for hydrologic functions and processes, aquatic habitats and the species that depend on them.

Cumulative Effects on Species Diversity

Forest plan level decisions for any alternative are expected to maintain and improve habitats and maintain viability for aquatic species on National Forest System lands. These decisions include desired conditions, objectives, standards and guidelines for maintaining or improving all watersheds, priority watersheds, protecting key watersheds, protecting and restoring riparian management areas, Water Quality, decisions regarding Suitability of riparian management areas for various management uses, investment in active restoration of National Forest System lands in priority watersheds, monitoring of watershed, riparian and aquatic habitat conditions, combined with designation of key watersheds, active restoration, and monitoring of watershed, riparian and aquatic habitat conditions,

When combined with other components of the regional restoration and conservation strategy that are outside the scope of the plan decision, (multiple scale assessments, designation of key watersheds), implementation of those components of the strategy that constitute plan level decisions, (restoration, riparian management areas, and monitoring) are not expected to prevent the listing of any species or distinct population segment, mainly because Federal land management agencies are responsible only for the habitat they manage. State agencies are responsible for populations on all lands and for the regulation of activities that affect populations and habitats on other ownerships. For listed salmon and trout, factors outside the responsibility of Federal land managers contribute to the status and trends of populations. These include changes in freshwater and estuarine habitats; harvest in commercial and recreational fisheries; management of dams; and the effects of hatchery practices and introductions (NMFS 2008).

Per Kostow (2003), fish-bearing streams in the John Day River Basin historically relied on extensive headwater beaver meadows for water storage and related maintenance of base flows that contributed to cooler water temperatures during the low flow season. These headwater meadows were largely lost in the late 1800s, which changed the hydrology of the lower mainstem. The lower Umatilla and Walla Walla rivers are severely modified by irrigation diversions, which have resulted in elevated water temperatures and abnormally low flows during the low flow season. In the years since 2003, a bucket-for-bucket program has begun providing water from the Columbia River for Umatilla Basin irrigators, which allows more water to remain in the Umatilla River mainstem during the low flow season, thereby contributing to suitable migration and spawning conditions for the Chinook salmon stock reintroduced by the Confederated Tribes of the Umatilla Indian Reservation in recent years. Kostow (2003) speculated that all major rivers in the Middle Columbia River basin once provided rearing habitat for freshwater redband trout historically, based on current redband trout populations present in the lower mainstem Deschutes River, but that those other river populations have gone extinct as a result of water withdrawals for irrigation and other purposes, leading to poor rearing habitat quality and quantity in summer and fall due to low flows and elevated water temperatures. This possible loss of mainstem habitats and populations may have contributed to reduced viability of redband populations on National Forest System lands due to loss of spatial and genetic connectivity and diversity within each subbasin.

The entire Crooked River is above the Pelton-Round Butte and Bowman dams and was probably the major steelhead production area historically. Much of the mainstem Crooked River, and the entire South Fork, are now severely impacted by irrigation and cattle grazing. These activities have lowered water tables, caused passage blockages, dewatered reaches, and decreased water quality (Kostow 2003). Many of the headwater areas still have good desert trout habitats, although the best remaining habitats are limited. If habitat has been fragmented or lost and the

potential for dispersal and recolonization is limited by barriers or by loss of the migratory life history in the case of bull trout, lagged extinctions in presently occupied habitat may be anticipated. When habitat is lost more rapidly than populations, a ‘‘debt of extinction’’ is incurred (Hanski et al. 1996), so even if further habitat loss is prevented, local extinctions would continue to occur until a new equilibrium between extinction and recolonization is established. The implication is that conservation of existing habitats alone may not be adequate for the long-term conservation of some species.

Active cooperation between the Forest Service, other Federal agencies, the states, Tribes, and local interest groups and organizations is important to national forest fish and wildlife programs, and programs integrated between different parties promote a synergy that leads to faster restoration of fish and fish habitats at the landscape scale than would likely occur only with funds appropriated to the Forest Service by Congress for these purposes.

Forest Vegetation

Introduction

This section describes and analyzes the forest potential natural vegetation types of the Malheur, Wallowa-Whitman and Umatilla National Forests. For the purpose of this analysis, vegetation in the Blue Mountains was classified into broad categories of forest, woodland, grassland, or shrubland. Categories were further classified as upland or riparian vegetation. The riparian vegetation is described in more detail in the Watershed section of Chapter 3. Shrubland, woodland, and grassland are discussed in the “Livestock Grazing” section of Chapter 3. This section quantifies and compares the degree to which the current condition of the forest vegetation’s overstory structure, size class, and density is different from desired conditions. It then projects what the trends in those characteristics would be after fully implementing the forest vegetation treatment objectives in each alternative. The processes, threats and risks that have caused deviations from desired conditions are also discussed. This section also examines the state of aspen and whitebark pine on the National Forests.

Changes Made Between the Draft and Final Environmental Impact Statements

Aside from the global changes throughout this environmental impact statement described in the Preface to this document (see Volume 1), the following changes were made specifically to this section:

Additional Background and Context Information Provided Regarding Methodology and Historic Range of Variation: In reviewing public comments regarding historical range of variability and the forest vegetation modeling in general, it was apparent that providing additional information and improving the clarity of this section would help readers and stakeholders understand the definitions, ideas and context surrounding these processes. Discussion was added to the “Affected Environment” section.

Corrections to the Table Depicting the Proportions of Wallowa-Whitman National Forest Included in each Potential Vegetation Group: Between the development of the Draft and the Final Environmental Impact Statement, mathematical errors were detected in some of the calculations behind the results presented in the table, which depicts the percent of the Wallowa-Whitman National Forest’s total land area represented by each potential vegetation group. All

values pertaining to the Wallowa-Whitman National Forest, which were incorrectly presented in the Draft Environmental Impact Statement, have been corrected.

Methodology

Forest Vegetation Classification Approach

To structure the analysis of the forest vegetation and changes associated with the different management alternatives, the potential natural vegetation concept was used along with a classification system of the existing vegetation. Potential natural vegetation is the plant community that would be expected to establish under existing environmental conditions in the absence of significant disturbance or human involvement. Some have criticized the potential vegetation concept as problematic for a variety of reasons (Chiarucci et al. 2010). However, the idea of potential natural vegetation is thought to be useful and compatible with existing widely used Forest Service classification systems and models. Forest Service used potential vegetation groups similar to those described by Powell et al. (2007). The three mid-scale upland forest potential vegetation groups selected were cold upland forest, moist upland forest, and dry upland forest. The potential vegetation groups are aggregations of plant communities and plant associations as described by Johnson 1987 and 1992.

The existing condition of the forest vegetation was characterized by examining the Forest Service existing vegetation polygon data. The existing vegetation database contains summarized information for each of the polygons mapped on their respective vegetation layers. Data sources for individual polygons vary, but include walk-through examinations, photo-interpretation, intensive stand examination plot data, and Most Similar Neighbor modeling. Summary information generally includes eco-class, potential vegetation group, existing vegetation cover type, structural stage, size class, density class, and age. The Pacific Northwest Region of the Forest Service has standards for the classification of vegetation, which were used during the process of developing a consistent set of structural stages for the forest plan revision. However, the regional standards do not mandate a specific structure classification system, but instead provide flexibility to develop a classification scheme based on several different systems.

All three National Forests within the Blue Mountains used a slightly different structural stage classification developed from guidance in the 1995 Regional Forester's Forest Plan Amendment No. 2 document. It was further decided that the forest plan revision effort would use a consistent structural stage classification system based on Interior Columbia Basin Ecosystem Management Project science, which was also consistent with the Pacific Northwest Regional standards. It was also decided that the revision effort would use a potential vegetation classification system that linked to the Interior Columbia Basin science. The structural stages chosen were stand initiation, stem exclusion, understory reinitiation, old forest single-story, and old forest multi-story. These structural stages are similar to those described in O'Hara et al. (1996), Oliver and Larson (1996), and Hessburg et al. (1999). See the "Existing Condition" section below for further descriptions of the structural stages used in this analysis. The cover type (dominant species composition) and general density class was also assigned to each of five main structural stages. Acreage within each potential vegetation group is static, because it is based on a combination of several factors such as topography, elevation, aspect, soil type, soil moisture and temperature, ambient air temperature, and associated biotic influences. However, the acreage within each potential vegetation group structural stage will vary over time because of management treatments, natural succession and other disturbance factors.

Vegetation Modeling

To simulate the effects of management, disturbances and natural succession over time, the existing vegetation data was summarized and organized into an "initial condition" format that was compatible for use with the Vegetation Development Dynamics Tool (VDDT) model (ESSA Technologies Ltd. 2007). The model is a relatively easy-to-run and user-friendly program that can be run on a desktop personal computer. It provides a modeling framework for examining the effects of succession, various disturbance agents and management actions on forest vegetation. The model was designed to project changes in vegetation over long periods of time. The interaction of these factors can be quite complex and sometimes counterintuitive, but projecting these changes and incorporating how they interact with one another is a very important part of a landscape scale analysis.

The different areas of forest potential vegetation group within each national forest were organized into model "state-classes." Each state-class represents a unique combination of potential vegetation group, structure, species composition, size, and density. The Vegetation Dynamics Development Tool model then moves portions of each state-class from one class to another class based on a set of transition pathways. These pathways can be either deterministic (e.g. gradual succession over time), or probabilistic transitions, which are random events whose occurrence is driven largely by probabilities. For each simulation, the landscape is partitioned into a number of "cells" or simulation units; each initially assigned to a state-class (i.e., cover type and structural stage) and age. For each time step (year) the model simulates the probability of each cell being affected by one of the transition types, and if a transition does occur, moves the cell to the resulting state-class as defined in the pathways diagram. The structure of the model allows runs of hundreds of years and many repeated "Monte Carlo" simulations to generate averages and associated variability of state-class abundance and disturbance occurrence. The details of the models, including the probabilities, pathways and time intervals required among transitions were originally developed as a part of the Integrated Analysis of Landscape Management Scenarios Project in the upper Grande Ronde River Subbasin in the late 1990s (Hemstrom et al. 2007). Annual variability for both wildfire and insect outbreaks is included in the model by using a set of multipliers that was developed using expert opinion from local fire managers and forest pathologists and entomologists to reflect the expected frequency and severity of fire years and insect outbreaks.

One acknowledged drawback of this type of model is that transition probabilities and pathways of each individual cell are independent of the state of the other cells. Thus, the model is not spatially explicit, and so does not simulate contagion in space (such as wildfire) or time (such as insect outbreaks) (ESSA Technologies Ltd. 2007).

As a result of the original project work in the Grande Ronde Subbasin, five different submodels were developed through literature searches, expert opinion and simulating management practices with current vegetation survey data. All of these were built around potential vegetation groups found in the Blue Mountains (Powell et al. 2007). The following table displays descriptions of the six different Vegetation Dynamics Development Tool forest submodels used to simulate the effects of the alternatives on forest vegetation.

Table 264. Vegetation Dynamics Development Tool Submodel descriptions

Potential Vegetation Group	VDDT Submodel	Description
Cold Upland Forest	CD	Whitebark pine forest
Cold Upland Forest	CD	Cold dry forest (subalpine, spruce, lodgepole)
Moist Upland Forest	CM	Moist grand fir, spruce, lodgepole, larch
Dry Upland Forest	DG	Dry grand fir forest
Dry Upland Forest	DD	Dry Douglas-fir forest
Dry Upland Forest	DP	Dry ponderosa pine forest
Dry Upland Forest	XP	Hot/dry ponderosa pine

The modeled forest landscapes were further broken into four basic management area allocations, called “strata” in the Vegetation Dynamics Development Tool model. This was done so different levels of treatments could be distributed among the area represented by each model strata based on the design of the alternatives. The model’s strata were based on a combination of the management areas in each alternative, and corresponding levels and types of treatment assumptions for each alternative (see following table). Each of the submodels in the previous table were included in each of the strata outlined in the following table. The determination of what portion of each forest potential vegetation group would fall into which model strata varied by each alternative’s approach to management area allocation and suitability. This initial breakdown was determined by overlaying each alternative’s Geographic Information Systems management layer data onto the forest vegetation layer.

Table 265. Harvesting assumptions within the Vegetation Dynamics Development Tool model management area strata

Model Strata	Primary Management Area or Suitability	Percent of Harvesting Activity Allocated to the Strata
Wilderness Areas	MA 1 (wilderness areas)	0%
Minimal Management/Roadless Areas	MA 3A and 3B (backcountry) and MA 2B (RNAs)	1%
Low Level Management Reserve Areas	MA 2s (special areas), MA 4B Old Forest, and MA 4C Riparian Management Areas	10 - 20%
General Forest/Active Management Areas	MA 4A General forest/Lands Suitable for Timber Production	80 - 90%

In addition to the level of harvesting within each model stratum, assumptions were also made about the allocation of treatments between each of the forest potential vegetation groups. The following table displays the assumed distribution of treatments between the cold, moist, and dry upland forests. Because the dry upland forest is the most highly departed from desired conditions and it also represents the majority of the general forest/active management stratum, for modeling purposes, it was assumed that the majority of treatments would continue to occur in the dry upland forest potential vegetation group. However, treatments would also occur in the moist and cold upland forests and the specific decisions regarding implementation of future projects will be made on a case-by-case basis.

Table 266. Treatment distribution modeling assumptions by potential vegetation group

Potential Vegetation Group	Approximate Treatment Distribution Between Potential Vegetation Groups Alternatives A thru F	Approximate Treatment Distribution Between Potential Vegetation Groups Alternatives E-Modified and E-Modified Departure
Cold Upland Forest	5 - 10%	< 5%
Moist Upland Forest	10 - 30%	5-20%
Dry Upland Forest	60 - 90%	80-95%

Each alternative was run through the Vegetation Dynamics Development Tool model for a least 5 simulations, each with a length of 80 years. Output data for each alternative was generated and analyzed to characterize the average amount of the different changes and management treatments that had occurred. Output data was also analyzed to show the distribution of ending state-classes, which could then be sorted and summarized into projected vegetation conditions at any future time period.

Forest Vegetation – Affected Environment

The Blue Mountains of northeastern Oregon range from approximately 1,000 to nearly 10,000 feet in elevation. Most of the higher elevations have been glaciated in the past. The landscape includes mountains with narrow valleys, basins, alpine meadows, and breaklands. Maritime climate, westerly winds, and mountainous terrain yield less than 10 inches of precipitation at the lowest elevations to more than 80 inches in mountainous areas. The dry upland forest, moist upland forest, and cold upland forest potential vegetation groups are currently dominated by Douglas-fir, ponderosa pine, western larch, subalpine fir, Engelmann spruce, lodgepole pine, and grand fir forest cover types. Soils in many areas are only moderately productive because of shallow depths associated with cold temperatures and low precipitation. The most productive soils occur in valleys and basins where soils are often deep and have high water-holding capacity due to their increased volcanic ash content. The dominant valley bottom settings include both steep, confined valleys with step-pool and rapids dominated streams, and broad, gently sloping valleys with meandering streams in well-developed floodplains at lower elevations (Quigley et al. 1996). Approximately 80 to 90 percent of the National Forest System lands in the Blue Mountains are comprised of upland forest potential vegetation groups.

Dry upland forests generally occur at low to moderate elevations in the montane vegetation zone. Climate varies with elevation, but common features include warm, dry summers, with warm to hot daytime temperatures and cool nighttime temperatures, and cold, wet winters. Much of the annual precipitation falls as snow in winter or during spring rainstorms. Dry upland forests in the Blue Mountains are water-limited, meaning water stress during the warm growing season is the primary factor limiting tree growth at low elevations (Brubaker 1980). Late-seral stands are dominated by ponderosa pine, Douglas-fir or grand fir. Ponderosa pine or Douglas-fir will also be found as cover types in early and mid-seral successional stages. Dry forests generally begin where the lower elevation woodlands and shrublands begin to transition into higher sites capable of carrying more substantial forest cover. The moist upland forests form their upper elevation transition boundary.

History

Historically, the dry upland forest potential vegetation group experienced disturbance regimes that included frequent fire. These frequently occurring fires were predominantly low-severity

surface fires occurring at intervals of less than 20 to 25 years (Johnston 2016, Barrett et al. 1997), but mixed-severity and some high-severity fire also occurred occasionally (Perry et al. 2011). Under a naturally functioning fire regime, the dry upland forest potential vegetation group was dominated by ponderosa pine and Douglas-fir, because these species were best adapted to survive and reproduce along with frequent fire. While larger-diameter, old trees typically survived these low severity fires, younger, smaller-diameter trees and tree species that were less fire-tolerant were often killed. The historical fire regime created and maintained a generally open forest structure, with a small-scale mosaic pattern of clumps or patches of trees often dominated by large diameter, old ponderosa pines, scattered individual trees, and openings that contained an abundance of native grasses and shrubs (Churchill et al. 2013, Larson and Churchill 2012, and Franklin et al. 2008). This spatial heterogeneity is a key structural element of a properly functioning dry upland forest (Franklin et al. 2008). The frequent fires in the dry upland forest potential vegetation group also maintained relatively low fuel loadings.

Moist upland forests occur at moderate elevations in the montane vegetation zone, or at the lower end of the subalpine zone. They are adjoined by cold upland forests at their upper edge and by dry upland forests at their lower edge. They are characterized by slightly longer growing seasons compared to the cold upland forest, and generally have cooler temperatures and higher precipitation than the lower elevation dry upland forests. Late-successional stands are generally dominated by subalpine fir, grand fir or Douglas-fir. Lodgepole pine or western larch often occur as dominant species in early successional moist upland forests. Douglas-fir and western white pine are common mid-seral species. Historically, the moist upland forest potential vegetation group was generally characterized by moderate or mixed-severity fires occurring every 40 to100 years (Stine et al. 2014; Hessburg et al. 2016). In a mixed-severity fire regime, fire alternates between stand-replacing crown fires that kill all trees to nonlethal, low-intensity surface fires that leave patches of living trees. Historically, the moist upland forest landscape was a mosaic driven by variation in climate, soils, topography, and low- to mixed- and occasional high-severity fire. Mixed-severity fires create a patchiness of forest structure, composition, and seral status that can be observed and quantified at an intermediate scale, with patch sizes ranging from a fraction of an acre to tens or hundreds of acres, depending on locale and climatic drivers. In moist upland forest types that were naturally dominated by mixed-severity fire regimes, the resulting highly variable structures and compositions would tend to render them among the most diverse and complex of all forest types (Perry et al. 2011; Stine et al. 2014; Hessburg et al. 2016).

Cold upland forests occur at moderate or high elevations in the subalpine zone and are characterized by cold, wet winters, and mild, relatively cool and dry summers. Deep, persistent winter snowpacks are common. Cold upland forests have relatively short growing seasons, low air and soil temperatures, and slow nutrient cycling rates. Late successional stands are typically dominated by subalpine fir, grand fir, Engelmann spruce, whitebark pine and lodgepole pine. Whitebark pine, lodgepole pine and western larch are more common as early successional species, but they often persist in older stands. Cold upland forests are adjoined by a treeless alpine zone at their upper edge (often separated by a narrow zone of dwarf or krummholz trees), and by moist upland forests at their lower elevation transition boundary. Smaller scale disturbances, such as windthrow, are common in the cold upland forests, but the fire regime is characterized by high-severity or stand-replacing fire events that occur very infrequently, generally at return intervals of 150 to 300 years. On drier high-elevation sites, high-severity fires sometimes perpetuate forests of lodgepole pine. These stand-replacing fires usually occurred every 100 to 200 years. However, when these fires do not occur, these lodgepole stands often succumb to attacks by mountain pine beetle or are gradually replaced by more shade-tolerant species, such as fir and spruce.

The dry and moist upland forests are the most common forest zones in the Blue Mountains, and they have a long history of human use for commodity purposes (such as livestock grazing and timber production). European settlement began broadly impacting the frequent-fire forests in the mid-19th century (Hessburg and Agee 2003). Since that time, numerous factors, including fire exclusion and suppression, timber harvest, introduction of nonnative plant species, and livestock grazing, have altered the natural fire regimes in the Blue Mountains. Intense grazing by millions of head of domestic cattle and sheep was an early and pervasive disturbance that eliminated ground fuels and grasses that would have normally carried the low and mixed severity surface fires that naturally thinned the forest. Suppression of grass and shrub competition also created conditions more favorable to tree regeneration (Noss et al. 2006). Extensive logging of the accessible portions of the dry and moist forests began with local settlement and utilization of timber resources. Initially logging focused on selecting individual trees of the larger merchantable species. These practices tended to promote the regeneration of shade tolerant, less fire adapted species like grand fir.

Wildfire suppression, which was formally adopted as policy by the Forest Service over 100 years ago and became effective in the 1930s, was another major influence. Dry upland forests and areas of moist upland forests that historically experienced relatively frequent, low- and mixed-severity fires have now missed have been a natural recurrence of several fires due to decades of fire exclusion and suppression. Tree regeneration that naturally would have been thinned by fire continued to grow into dense stands of fire-vulnerable species, ultimately forming multi-storied, closed canopy structures. The historically open stands within the dry upland forest potential vegetation group, with their mosaic pattern of tree clumps or patches and openings, have now filled in with younger trees, resulting in a more uniform stand structure, increased ladder fuels, increased stand densities, increased fuel continuity, and decreased variety of spatial patterns. Increased stand densities and a reduction in low severity fire events on dry and moist sites has also contributed to a shift from shade intolerant/fire tolerant tree species, such as ponderosa pine or western larch, to more shade tolerant and fire or disease prone species, such as grand fir. Because of these altered processes, some of the key changes that have developed, particularly within the dry upland forests and moist upland mixed conifer forests, include:

- Creation of a simplified landscape vegetation mosaic dominated by a surplus of dense young and mid-aged forests and a lack of old mature forests.
- A shifting of tree species composition away from a species mix that is well adapted and resilient to historical levels of disturbance agents like fire, drought, insects and diseases.
- An increased susceptibility to large and severe fires, insect outbreaks, and widespread disease.

A small number of scientists contend these views (such as Williams and Baker 2012), but most scientists today agree that these forests neither resemble nor function as they once did. Density and fuel loadings within dry and moist conifer forests and landscapes has increased dramatically as a result of the human activities outlined above. This has greatly increased their vulnerability to wildfire, drought, insect/disease outbreaks and climate changes. The nature of these changes along with possible restoration strategies and barriers have been outlined in recent years by numerous forest scientists and ecologists including Franklin and Johnson (2012), Stine et al. (2014), Franklin et al. (2014), Haugo et al. (2015), Hessburg et al. (2015) and Hessburg et al. (2016).

Historical Range of Variability Analysis

A historical range of variability analysis was completed to provide a set of forest vegetation reference conditions. These reference conditions provide an ecological basis from which to compare existing conditions and the effects of different management options. Current forest vegetation conditions can be evaluated against these reference conditions, not only to determine degrees of change, but also to design management regimes and treatments that will be able to provide human society with valuable resources and services while returning highly departed, at-risk ecosystems to a more natural and sustainable condition (Hessburg et al. 1999; Swetnam et al. 1999). The departure of current conditions from reference conditions can be used to prioritize and select areas for possible restoration treatments or to highlight areas in particular need of conservation.

The historical range of variability concept is used to characterize the degree of normal fluctuations in ecosystem conditions and processes over a period of time. Ecosystem conditions change as the result of disturbance processes. Managers initially used ‘‘target’’ forest vegetation conditions developed from historical evidence to craft treatment prescriptions and prioritize areas. However, these target conditions tended to be subjective and were considered somewhat arbitrary by some because they represented only one possible “snap-shot” condition from a wide range of possibilities (Keane et al. 2002). Historical range of variability, on the other hand, is not intended to portray a static, unchanging condition. Ecosystems within the Blue Mountains evolved with disturbances, including wildfire, insects, diseases, landslides, human uses, changing weather patterns, and other factors (Powell 2012). The historical range of variability concept recognizes that ecosystem components have a range of conditions within which they are resilient and self-sustaining (Egan and Howell 2001, Holling and Meffe 1996). The historical range of variability is meant to characterize a reasonable range of vegetation composition, structure, and density conditions that would be produced by these disturbance agents under naturally functioning ecosystem processes (Morgan et al. 1994).

A key idea behind the use of historical range of variability is that if landscapes are maintained within the historical range then the conditions should be sustainable over time. This is based on the premise that since native plant and animal species have evolved with, and are adapted to, the historical disturbance regimes and resulting conditions of an area, ecosystem components occurring within their historical range should represent sustainable conditions (Aplet and Keeton 1999, Swanson et al. 1994). A historical range of variability approach should also provide a means of ensuring that the long-term consequences of management activities are consistent with maintaining the conditions under which native species and ecosystem processes evolved (Delong and Tanner 1996).

Some believe that conditions based on historical range of variability should not be used as reference conditions to guide management activities because climate change projections anticipate a warmer and drier climate. For example, old-growth forests that established 300 to 500 years ago and grew under the cold climates of the Little Ice Age (ca. 1600–1850) may not be good examples of forests that will be appropriately adapted to drought anticipated for the 21st century. Halofsky and Peterson (2017) suggest that future climates may trigger major changes in disturbance processes, plant species dynamics, and hydrological processes.

However, Keane et al. (2009) suggest that using historical range of variability may still be the most viable approach for the near-term because it entails the least amount of uncertainty, particularly as compared to the uncertainty associated with the magnitude, timing, scale, and spatial extent of climate change impacts. Keane et al. (2009) also point out that until technology

has improved and new models have been thoroughly validated (given the uncertainties in predicting climatic and ecological responses to increasing carbon dioxide), using a historical range of variability based on the past may provide more certainty than attempting to simulate the future. Similarly, Fulé (2008) maintains that the use of historical reference conditions to guide management remains valid because forests were historically much more resilient to disturbance and drought than they are today. Adapting reference conditions to future climates is valid. If the historical ranges are sufficiently broad, adequate “management space” should remain available to incorporate many recommended climate adaptation strategies (Halofsky and Peterson 2017).

Estimates of the historical range of variability for forest structural stages, species composition and stand density were developed for this analysis in 2007 through modeling using the Vegetation Dynamics Development Tool (VDDT). Using computer models to quantify the historical range of variability is a common method. It involves using computer models to simulate historical dynamics to produce a time series of simulated data to compute statistics and metrics. This approach relies on the accurate estimation of natural succession and disturbance processes, and it is limited by the tool’s inability to incorporate spatial contagion. However, the methods used for this analysis were generally consistent with previous historical range of variability characterizations completed by scientists in the inland Northwest (Hann et al. 1997; Hemstrom et al. 2007).

The models were run on representations of 4.3 million acres of forest land within the Malheur, Umatilla, and Wallowa-Whitman National Forests. Initial landscape conditions were developed from the existing vegetation layer as previously described. The length of each simulation was 500 years. The degree of variation in the output generally stabilized after 200 to 400 years. We analyzed the output from year 200 to year 500 to develop our historical ranges of variability. These results were summarized for 30 different modeling simulations from model year 200 to year 500. The mean values for the results over this 300-year time period were calculated. The extent of the historical range was calculated as two standard deviations around these means. Results were summarized into three potential vegetation groups (cold, moist, and dry upland forest).

The reference conditions and historical range of variability generated by the Vegetation Dynamics Development Tool were used as the primary basis for developing the desired conditions for forest vegetation structure, density, and species compositions. Broad-scale assessments of the interior northwest and Columbia River basin suggest that upland forest ecosystems could be characterized as healthy and resilient if these primary ecosystem components were restored to, or maintained in, conditions similar to the historical range (Quigley et al. 1996; Lehmkuhl et al. 1994; Franklin and Johnson 2012; Stine et al. 2014; Hessburg et al. 2015). The underlying assumption is that these forest ecosystems will be sustainable and resilient to natural disturbances and climate change if they exist in a condition close to that under which they evolved (Morgan et al. 1994).

Forest Vegetation – Existing Condition

Table 267 displays the proportion of each National Forest represented by each of the potential vegetation groups. The National Forests within the Blue Mountains consist mostly of upland forest potential vegetation groups (approximately 78 to 87 percent), with an additional 13 to 22 percent comprised of juniper woodlands, shrublands, grasslands and nonvegetation (rock, water). The three mid-scale upland forest potential vegetation groups (cold upland forest, moist upland forest, and dry upland forest) of the Blue Mountains national forests differ in their distribution across the Forests. The Malheur National Forest uplands are dominated by the dry upland forest

potential vegetation group, and include only minor amounts of cold and moist forests. The Umatilla National Forest uplands are characterized by large amounts of both dry upland and moist upland forest. The Wallowa-Whitman National Forest upland forests are about one-half dry forest and equal minority proportions of both moist and cold upland forest. The Wallowa-Whitman has more cold upland forests than the other two Blue Mountains national forests. Despite these differences between individual forests, the dry upland forest is predominant across the region and makes up the bulk of the active management allocations across all three National Forests.

Table 267. Percent of each National Forest's total land area within each potential vegetation group

Potential Vegetation Group	Malheur	Umatilla	Wallowa-Whitman
Cold upland forest	**9%**	**8%**	**21%**
Moist upland forest	**6%**	**31%**	**21%**
Dry upland forest	**72%**	**42%**	**36%**
Cold riparian forest	T*	T	T
Low soil moisture riparian forest	T	T	T
Warm riparian forest	T	T	T
Moist upland woodland (juniper)	3%	1%	1%
Dry upland woodland (juniper)	T	T	1%
Cold upland shrubland	T	T	1%
Moist upland shrubland	T	2%	1%
Dry upland shrubland	6%	1%	1%
Cold riparian shrubland	T	T	T
Warm riparian shrubland	T	T	T
Low soil moisture riparian shrubland	T	T	T
Cold upland herbland	T	T	2%
Moist upland herbland	T	1%	1%
Dry upland herbland	2%	13%	8%
Cold riparian herbland	T	T	T
Warm riparian herbland	T	T	T
Low soil moisture riparian herbland	T	T	T
Non-vegetation or other	T	T	4%
Totals (acres are rounded approximates)	100% (1,700,000 acres)	100% (1,400,000 acres)	100% (1,800,000 acres)

* T indicates trace (less than 1 percent)

Forest Structural Stages

The vertical and horizontal structural arrangement of forest vegetation as well as the size and arrangement of grasses and shrubs are all important components related to wildlife habitat, insects and diseases, wildfire hazard, scenic integrity and social and economic products, such as timber and culturally significant foods. The structural stages chosen for this analysis were stand initiation, stem exclusion, understory reinitiation, old forest single-story and old forest multi-story. Forest vegetation for the Blue Mountains national forests was classified using these structural stages, which are similar to those described in O'Hara et al. (1996), Oliver and Larson

(1996), and Hessburg et al. (1999). See Figure 5 in the Forest Plans for a graphical depiction of the structural stages used in this analysis.

Stand Initiation Stage (SI) – Young stands that develop following a stand-replacing disturbance such as wildfire or a regeneration timber harvest. Growing space is typically reoccupied rapidly by vegetation that either survives the disturbance or colonizes the area. Forest vegetation within these stands typically either survive the disturbance above ground, initiate regrowth from their underground roots, or regenerate from seeds stored on-site. Colonizers also disperse seed into disturbed areas, the seed germinates, and then new seedlings establish and develop. A single canopy layer of young trees is typically present in this stage. Average dominant tree diameters are usually less than five inches.

Stem Exclusion Stage (SE) - The stage is usually created when vigorous, fast growing trees that compete strongly with one another for available light and moisture fully occupy the growing space. Because trees in this stage have grown taller, and the growing space is fully utilized, establishment of new trees in the understory is generally precluded by a lack of sunlight and/or moisture. Individuals that compete unsuccessfully are stressed and may die. These stands typically only have one dominant layer. For analysis purposes, all single-layered stands with average overstory tree diameters ranging generally from 5 to 20 inches were classified as stem exclusion stage

Understory Reinitiation (UR) – As the forest continues to develop, new age classes of trees establish during this stage as the original individual overstory trees die or are removed. The original trees no longer occupy all of the growing space. Regrowth of understory vegetation then occurs, and trees begin to develop into distinct vertical layers. Average tree overstory diameters range from 5 to 20 inches.

Old Forest Single-story (OFSS) - This structure stage typically results from low-intensity surface fire. It can include multiple age classes, but generally only includes one main overstory stratum. Large, old trees are common. Decaying fallen trees may also be present that leave a discontinuous overstory canopy. Overstory diameters are generally greater than 20 inches.

Old Forest Multi-story (OFMS) - This structure stage includes multiple age classes and vegetation layers, similar to the understory reinitiation stage, but also along with numerous large, old trees. Decaying fallen trees may also be present that leave a discontinuous overstory canopy. Overstory diameters are generally greater than 20 inches.

For each national forest, Table 268 displays the existing forest structural stages as a percent of each upland forest potential vegetation group and compares each to the historical range of variability.

The distribution of structural stages among the different potential vegetation groups as depicted by the historical range of variability reflects the different natural fire regimes of each group. The historical range of variability analysis shows that within the cold upland forest potential vegetation group, the largest portions of the landscape tended to be represented by either the stand initiation or the old forest structural stages. The moist upland forest potential vegetation group was usually relatively evenly distributed between each of the forest structural stages, with a slightly higher percent of the landscape in the two old forest structural stages. Within the dry upland forest potential vegetation group, the historical range analysis indicates that the landscape was historically dominated by old forest structural stages, particularly in the single-storied stage.

Only a very small percent of the dry upland forest potential vegetation group would be expected to exist in the understory reinitiation structural stage.

Table 268. Existing forest structural stages as a percent of each upland forest potential vegetation group by national forest

Upland Forest PVG/Structural Stage	Historical Range of Variability (Desired Conditions)	Malheur	Umatilla	Wallowa-Whitman
Cold Upland Forest Stand Initiation	20% - 45%	24%	30%	14%
Cold Upland Forest Stem Exclusion	15% - 30%	12%	21%	10%
Cold Upland Forest Understory Reinitiation	10% - 25%	44%	18%	41%
Cold Upland Forest Old Forest Single-Story	5% - 20%	1%	0%	1%
Cold Upland Forest Old Forest Multi-Story	10% - 25%	20%	30%	34%
Moist Upland Forest Stand Initiation	20% - 30%	1%	9%	12%
Moist Upland Forest Stem Exclusion	20% - 30%	5%	10%	11%
Moist Upland Forest Understory Reinitiation	15% - 25%	41%	26%	50%
Moist Upland Forest Old Forest Single-Story	10% - 20%	5%	23%	1%
Moist Upland Forest Old Forest Multi-Story	15% - 20%	47%	32%	25%
Dry Upland Forest Stand Initiation	15% - 30%	6%	12%	14%
Dry Upland Forest Stem Exclusion	10% - 20%	18%	26%	16%
Dry Upland Forest Understory Reinitiation	< 5%	54%	50%	54%
Dry Upland Forest Old Forest Single-Story	40% - 65%	3%	4%	1%
Dry Upland Forest Old Forest Multi-Story	1% - 15%	20%	8%	14%

Figure 37 displays the amount of departure from the historical range of variability within the cold upland forest potential vegetation group by graphically comparing the existing and historical forest structural stages within each national forest. In general, existing conditions within the cold upland forest potential vegetation group exhibit a lesser amount of departure from the historical range of variability, in comparison to the moist and dry upland forest potential vegetation groups.

The historical fire regime in the cold upland forest potential vegetation group was characterized by high severity, stand-replacing fire events that occurred every 150 to 300 years or more. With such infrequent fire events, fire suppression has had less noticeable effects on the existing forest structures of the cold upland forest.

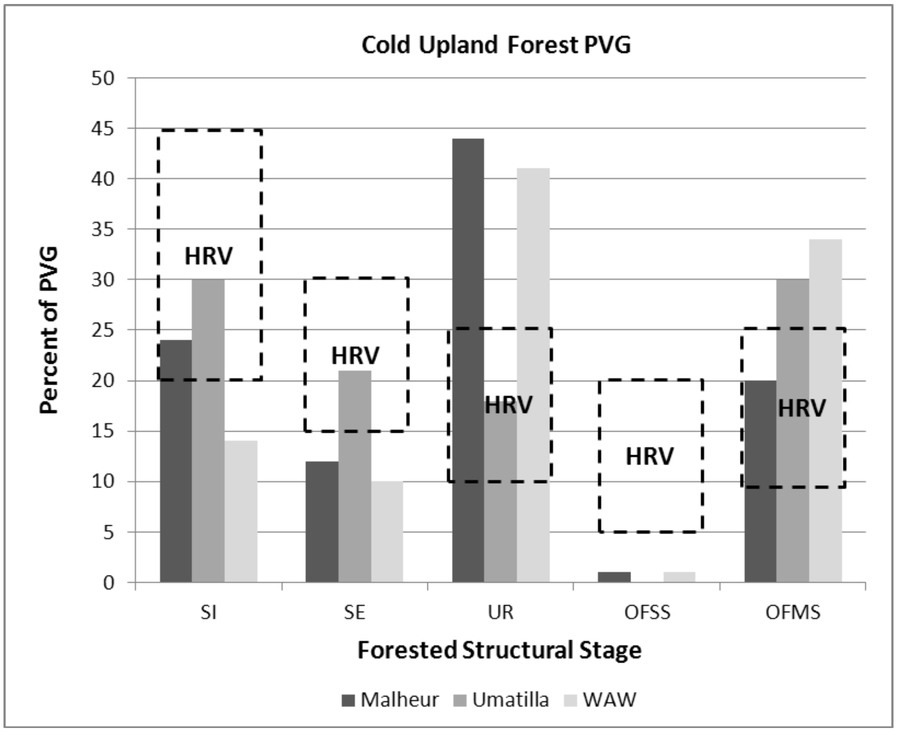

Figure 37. Existing forest structural stages (percent of potential vegetation group) and the historical range of variability (desired conditions) by national forest within the cold upland forest potential vegetation group
(HRV = historical range of variability; SI = stand initiation; SE = stem exclusion; UR = understory reinitiation; OFSS = old forest single story; OFMS = old forest multi-story)

The Wallowa-Whitman's cold upland forest is probably the most departed from the historical range of variability of the Blue Mountains national forests. None of the Wallowa-Whitman's cold forest structural stages is currently within the historical range. The Wallowa-Whitman has a particularly large excess of the understory reinitiation stages. The Malheur's stand initiation and multi-storied old forest stages are within historical range of variability, but the Malheur's cold upland forest is also unmistakably overrepresented in mid-aged understory reinitiation stages. In time, some of this understory reinitiation stage would likely develop into more mature old forest. In some cases, these understory reinitiation stages may develop into old forest, single-storied stages, which is currently underrepresented, but with the dominance of shade tolerant species like subalpine fir and Engelmann spruce, in many cases the existing understories would tend to persist and eventually develop into multi-storied old forests, which are already at or above the historical range of variation. The early and mid-aged stages of the Umatilla's cold forest are all currently within historical range of variability. The Umatilla has a modest excess of multi-storied old forests in the cold uplands, and a scarcity of single-storied old at the same time. These similar patterns, which are noted across the Blue Mountains national forests, may be indicative of the combination of past harvesting practices within old forest along with other management practices that have disrupted natural disturbance regimes.

Figure 38 displays the amount of departure from the historical range of variability within the moist upland forest potential vegetation group within each National Forest. The historical fire regime in the moist upland forest potential vegetation group was generally characterized by moderate or mixed-severity fire events that occurred every 40-100 years. After many decades of mostly successful fire suppression and exclusion efforts, in terms of average natural fire return intervals, some of these areas may have perhaps missed approximately one to three natural wildfire cycles. Therefore, fire suppression has had more noticeable effects on existing forest structures compared to the cold upland forest potential vegetation group. Historical timber harvesting has also likely played a bigger role within the moist upland forests than within the less accessible cold uplands.

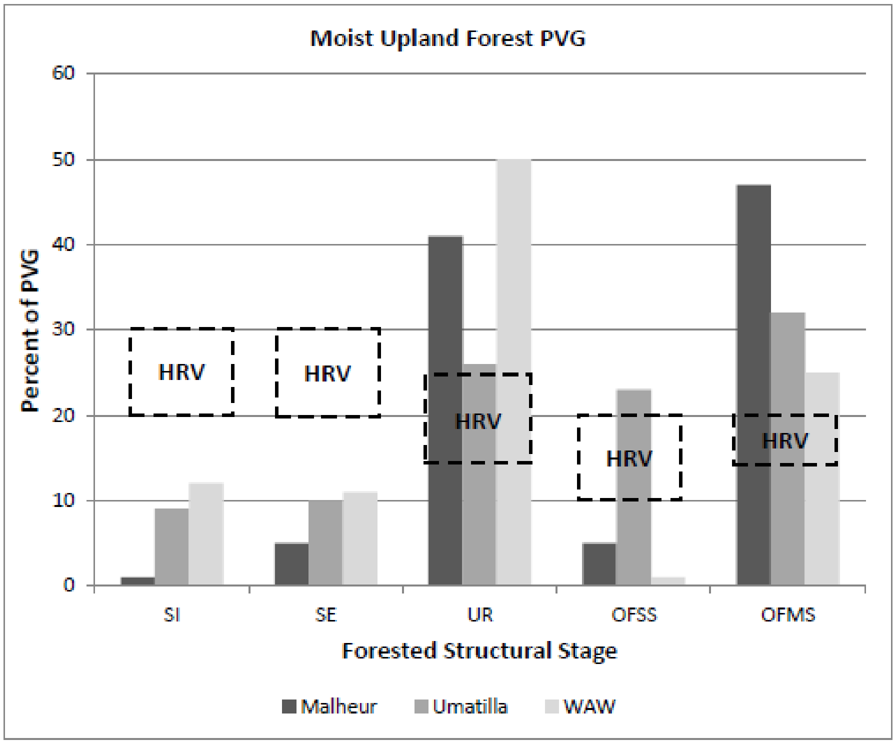

Figure 38. Existing forest structural stages (percent of potential vegetation group or PVG) and the historical range of variability (desired conditions) by national forest within the moist upland forest potential vegetation group
(HRV = historical range of variability; SI = stand initiation; SE = stem exclusion; UR = understory reinitiation; OFSS = old forest single story; OFMS = old forest multi-story)

In general, existing conditions within the moist upland forest potential vegetation group exhibit a greater amount of departure from the historical range when compared to the cold upland forest potential vegetation group (Figure 37). The general areas of similarity between the three National Forests in terms of departure from historical range of variability are a lack of both young stand initiation stages and mid-aged stem exclusion stages. As with the cold upland forests, the Wallowa-Whitman and Malheur National Forests both have pronounced excesses in the understory reinitiation stages and scarceness of old single-storied structures. Multi-storied stages of old moist upland forest are overrepresented on all three national forest landscapes, but the Umatilla's old multi-storied moist upland forest is noticeably closer to being within the historical range of variability than the other two National Forests. The Umatilla is unique in that its mid-

aged understory reinitiation stages are basically at the high end of being within the historical range, while the single-storied stages of old forest are actually slightly overrepresented.

Figure 39 displays the amount of departure from the historical range of variability within the dry upland forest potential vegetation group by comparing the existing and historical forest structural stages within each National Forest. The historical fire regime in the dry upland forest potential vegetation group was generally characterized by low- severity surface fires occurring at intervals of less than 20 to 25 years, with only occasional occurrences of mixed or high-severity wildfire. After decades of fire suppression and exclusion, in terms of average natural fire return intervals, the dry upland forest potential vegetation group has certainly missed multiple natural wildfire cycles over the last century.

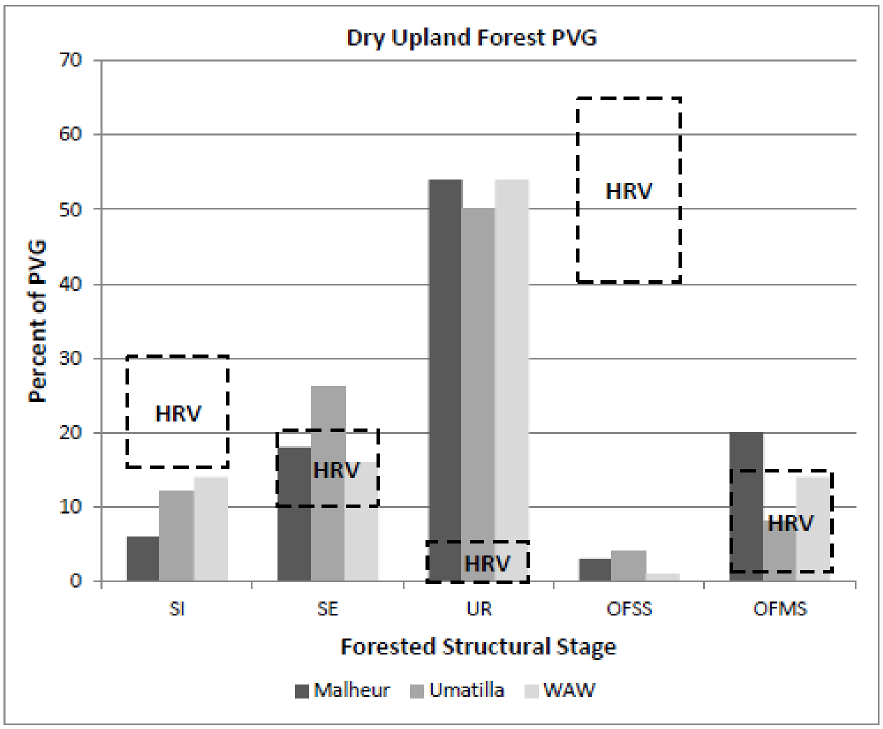

Figure 39. Existing forest structural stages (percent of potential vegetation group or PVG) and the historical range of variability (desired conditions) by national forest within the dry upland forest potential vegetation group
(HRV = historical range of variability; SI = stand initiation; SE = stem exclusion; UR = understory reinitiation; OFSS = old forest single story; OFMS = old forest multi-story)

These fire management policies, combined with historical timber harvesting practices have had substantial effects on existing forest structures and contributed to more highly departed landscapes. From its beginning, forest management of the National Forests emphasized what were perceived as efficient and productive forests capable of meeting the nation’s demands into the future. The emerging discipline of American forestry in the early 20th century held that inferior diseased and decadent trees needed to be removed and replaced with young, healthy, rapidly growing trees. Generally, this meant replacing many stands of the dry upland forest that were characterized by slower growing, old trees, with young, faster growing stands. As harvest of the largest, old trees, within the dry upland forest continued over decades, areas of old forest and their associated large, old trees declined dramatically throughout the Blue Mountains national

forests. The extent of the dry upland forest existing today in the old forest single-story structural stage ranges only from 1 to 4 percent versus a natural historical condition that is estimated to have been between 40 to 65 percent.

In general, as compared to the other forest potential vegetation groups, existing conditions within the dry upland forest potential vegetation group tend to exhibit the greatest amount of departure from the historical range of variation. Within the dry upland forest landscape, all three National Forests are currently characterized by a vast disparity between the mid-aged understory reinitiation stages and the single-storied stages of old forest. The understory reinitiation stages are grossly overrepresented in terms of historical range of variability, while at the same time, single-storied old forests are now very uncommon. This pattern is a complete reversal of the structure stage distribution that would be expected to develop under a natural disturbance and stand development regime. The old forest was reduced primarily by historical harvesting practices as described above. The observed excess of mid-aged understory reinitiation stages within the dry upland forest landscape fits with what would be expected to result from successful past suppression of what would have developed into low and moderate severity wildfires. The absence of these fires has allowed uncharacteristic development of understory layers within areas that were historically maintained in more single-storied structures by relatively frequent surface wildfires.

In time, some of what are now mid-aged understory reinitiation stages will likely develop into additional mature old forest. However, without either low- to moderate-severity surface fire or active management treatments to control the understory density, these understory reinitiation stands are unlikely to develop into the severely lacking single-storied stages of old forest. Without some force acting upon the understory layers, the most probable transition paths for the current mid-aged understory reinitiation stands into the future would be either gradual aging and development into the already adequately represented multi-storied old forest stages, or abrupt change to stand initiation stages via severe disturbance. With a large proportion of these understory reinitiation stands lacking their historical representation of fire resistant species and older individual trees, the present structure distribution of large areas of the dry upland forest now supports an unusually severe wildfire regime. A high-severity fire regime within the current dry upland forest is more likely to “reset” large areas into the stand initiation stage, or convert stands to shrublands and grasslands, than it is to allow future development into more mature, fire-resistant, old single-storied forest structures.

Forest Species Composition

The tree species composition within different potential vegetation groups can significantly influence the wildfire, and insect and disease hazards in an area. The shade tolerance of tree species is a measure of a species ability to grow successfully and regenerate under shaded conditions. Common tree species of the Blue Mountains that are more intolerant of shaded conditions include ponderosa pine, lodgepole pine, western larch, and western white pine. Tree species that are relatively tolerant of shade include Engelmann spruce, subalpine fir and grand fir. The inland variety of Douglas-fir found in the Blue Mountains is generally considered intermediate along the shade tolerance continuum, more tolerant of shade than ponderosa pine, but much less tolerant of shade than its common associate, grand fir.

Common shade-intolerant tree species like ponderosa pine and western larch, as well as the intermediate Douglas-fir, tend to be better adapted to low severity surface fires and ponderosa pine and Douglas-fir also possess greater tolerance to drought conditions. Conversely, shade-

tolerant species like grand fir or subalpine fir are poorly adapted to resist wildfire damage, and their branching habits facilitate torching and crowning fire behaviors. These species of fir trees are also generally associated with a high susceptibility to attack from defoliating insects, root diseases, fir engraver beetles, stem decay, and other insects and diseases. Stress from drought and excessive stocking often exacerbate mortality caused by these agents. Much of the perceived increase in insect and disease activity and increasing vulnerability to stand replacing wildfire within the dry upland forest is related to the increased proportion of grand fir across the landscape (Hessburg et al. 1999; Stine et al. 2014).

The existing species composition for forest vegetation was characterized using the current vegetation survey data and by examining the Forest Service existing vegetation polygon data. The species cover type was determined by the dominant tree species based on basal area. The major forest cover types of each upland forest potential vegetation group were summarized into either the shade tolerant, intermediate tolerant or shade intolerant groups as shown in the table below.

Table 269. Crosswalk of cover type to species composition group

Potential Vegetation Group	Cover Type	Species Composition Group
Cold Upland Forest	Engelmann spruce	Shade tolerant
Cold Upland Forest	Subalpine fir	Shade tolerant
Cold Upland Forest	Douglas-fir/Grand fir	Intermediate tolerance
Cold Upland Forest	Whitebark pine	Shade intolerant
Cold Upland Forest	Lodgepole pine	Shade intolerant
Cold Upland Forest	Western larch	Shade intolerant
Cold Upland Forest	Western white pine	Shade intolerant
Moist Upland Forest	Grand fir	Shade tolerant
Moist Upland Forest	Engelmann spruce	Shade tolerant
Moist Upland Forest	Subalpine fir	Shade tolerant
Moist Upland Forest	Douglas-fir	Intermediate tolerance
Moist Upland Forest	Western larch	Shade intolerant
Moist Upland Forest	Ponderosa pine	Shade intolerant
Moist Upland Forest	Lodgepole pine	Shade intolerant
Moist Upland Forest	Western white pine	Shade intolerant
Dry Upland Forest	Grand fir/Douglas-fir	Shade tolerant
Dry Upland Forest	Ponderosa pine	Shade intolerant
Dry Upland Forest	Western larch	Shade intolerant

Table 270 displays the existing species composition as a percent of each upland forest potential vegetation group, and compares those conditions to the historical range of variability for species composition groups. A comparison of these two tables shows significant changes have occurred in species composition over time. The exclusion of wildfire and past timber harvesting and grazing practices have all contributed to a significant shift away from fire and drought tolerant tree species, as well as the introduction of invasive plant species (Stine et al. 2014; Hessburg et al. 2015).

The greatest areas of departure from the historical range of variability in terms of species composition are within the dry and moist upland forests. With the exception of the Malheur's dry upland forest, the shade tolerant species groups are now greatly overrepresented. Many landscape and stand-level species compositions have been modified by past harvests which removed large ponderosa pine, western larch, Douglas-fir and western white pine, while creating conditions favorable for regeneration of fire-sensitive shade tolerant species. White pine has also been negatively impacted by white pine blister rust. There have been significant increases in the distribution of grand fir noted across the region. Shade tolerant species like grand fir can regenerate and grow underneath overstories of more mature trees. In the absence of the natural thinning and weeding effect of low severity surface fires, the dense multi-layered structure that often results can greatly increase the potential fire behavior. Species compositions altered in this way can also result in increased moisture stress, increased susceptibility to insects and diseases, and decreased forest health (Hessburg et al. 1999; Stine et al. 2014; Hessburg et al. 2016).

Table 270. Existing species composition as a percent of each upland forest potential vegetation group by national forest compared to historical range of variability

Upland Forest PVG/Species Composition Group	Historical Range of Variability (Desired Conditions)	Malheur	Umatilla	Wallowa-Whitman
Cold Upland Forest Shade Intolerant	**40% - 60%**	63%	70%	38%
Cold Upland Forest Intermediate Tolerance	**5% - 20%**	31%	10%	24%
Cold Upland Forest Shade Tolerant	**25% - 50%**	7%	20%	38%
Moist Upland Forest Shade Intolerant	**30% - 60%**	21%	15%	27%
Moist Upland Forest Intermediate Tolerance	**20% - 40%**	6%	21%	27%
Moist Upland Forest Shade Tolerant	**10% - 30%**	73%	65%	46%
Dry Upland Forest Shade Intolerant	**75% - 90%**	76%	45%	45%
Dry Upland Forest Shade Tolerant	**5% - 20%**	24%	55%	55%

Many scientists have recognized that reversing these trends and converting back to a species like ponderosa pine may require significant effort (Stine et al. 2014; Hessburg et al. 2015; Hessburg et al. 2016). For example, Douglas-fir and grand fir regeneration has now become so uncharacteristically widespread within some areas, that continued seed rain and resulting regeneration from these species may make it difficult for ponderosa pine to reestablish as a dominant species even after fires.

Aspen

Although quaking aspen occurs in a wide variety of habitats (including soil type and moisture conditions), and at a great range of elevation throughout northern and western North America, stands of quaking aspen are uncommon and considered a unique habitat type in the Blue Mountains. Wildfires or other disturbances normally revitalized aspen clones, with some patches sprouting 24,000 to 49,000 stems per acre while regenerating after fires. Intense within-stand competition combined with ungulate browsing (both wild and domestic), and a host of stem cankers, foliar diseases, and insect defoliators would naturally thin aspen clones to one or two hundred stems per acre after several decades (Stine et al. 2014). As one of the few broadleaf deciduous trees in a region dominated by conifers and semi-desert grassland and scrub, aspen brings important diversity to the landscape. Aspen's palatable twigs and foliage, and tendency to

develop decay (which facilitates cavity excavation), make it valuable habitat for wildlife such as deer, elk, woodpeckers, beaver, songbirds, and small mammals. In the Blue Mountains, aspen tends to grow in moist sites such as topographic depressions, seeps, springs, lake margins, and often in riparian areas, providing shade, streambank stability, and nutrients from leaf-fall to streams. Aspen are also widely appreciated for their scenic value, especially their golden colors in the fall (Swanson et al. 2010).

Aspen populations within the Blue Mountains generally now exist as small, scattered, remnant stands of rapidly declining trees. According to Swanson et al. (2010), detailed inventories performed in some ranger districts have located hundreds of aspen stands broadly distributed within the Blue Mountains. Although these aspen stands are numerous, they are invariably small. An inventory of approximately 25 percent of the Malheur National Forest has revealed 1,327 stands, with a median stand area of less than 1 acre. Only 5 percent of the stands are greater than 10 acres. Within the Umatilla National Forest, an inventory of 514 stands also shows a median area of less than 1 acre and only 1 percent of the stands larger than 10 acres. The total basal area of aspen is also quite low (Swanson et al. 2010).

Within the Blue Mountains, aspen stands have declined over the past century due to fire suppression and browsing pressure from large ungulates (Shirley and Erickson 2001). Although succession is a natural event, the alteration of fire regimes and a lack of successful aspen recruitment have promoted a more consistent landscape level succession to conifers or grass/shrubland. In most aspen stands, regeneration has been suppressed to some degree by both fire suppression and browsing. Small clonal aspen patches, often imbedded within mixed-conifer forests, have been heavily affected, in part, because of their relatively short natural life expectancy (stands often begin to deteriorate at 55 to 60 years of age and are pathologically old and decadent at 90 to 110 years (Stine et al. 2014). While aspen root systems may persist for thousands of years, aspen trees have an average lifespan of between 100 and 150 years in the Rocky Mountains, although stands occasionally survive beyond 200 years (Burns and Hondkala 1990). Assuming the same holds true for aspen in the Blue Mountains, then most of the aspen trees may presently be approaching the end of their natural life cycles.

A decline in the area occupied by aspen can be inferred from observations of dead aspen representing former groves with no survivors. The predominance of clones where many individuals are decadent or dead, and the rarity of unbrowsed aspen suckers or young age cohorts also points toward a general decline (Swanson et al. 2010). Although little is known about the historic distribution of aspen in Oregon, it is believed that stands were once larger and more widely distributed (Shirley and Erickson 2001). However, historical photography (Skovlin and Thomas 1992) and early accounts (Bright 1994) indicate that aspen forests were never as widespread in the Blue Mountains as in other parts of the mountain west.

Based on a historical range of variability analysis, Swanson et al. (2010) recommended maintaining aspen stands within age and structural class distributions similar to those shown in the table below. They also note that since aspen occupied areas are largely considered deficit in this area, restoration treatments would ideally include expansion of the aspen areas in addition to manipulation of age and structural classes.

Table 271. Recommended aspen age and structural distributions from Swanson and others (2010)

Age (Years)	Structural Class	Proportion of Aspen Forest Area
0-40	Stand Initiation	45 – 50%
40-80	Stem Exclusion, Understory Reinitiation	45 – 50%
80+	Old Forest Multi-story, Old Forest Single Story	5 – 10%

Whitebark Pine

Whitebark pine (*Pinus albicaulis*), an important component of western high-elevation forests, has been declining in both the United States and Canada from the combined effects of the exotic disease white pine blister rust (caused by the fungal pathogen *Cronartium ribicola*), mountain pine beetle (*Dendroctonus ponderosae*) outbreaks, altered disturbance regimes in stands where whitebark pine is a seral species, and climate change. These combined threats led to the determination by the U.S. Fish and Wildlife Service, on July 18, 2011, that the species warrants protection under the Endangered Species Act. However, the Fish and Wildlife Service also determined that adding the species to the Federal List of Endangered and Threatened Wildlife and Plants is precluded by the need to address other listing actions of a higher priority, thus making it a Federal Candidate species. As a result of these circumstances, whitebark pine is considered a sensitive species in the Northwest Region of the Forest Service.

Whitebark pine seedlings survive on harsh, arid sites and may act as nurse trees to less hardy conifers and vegetation. At high elevations, it helps regulate snow melt and reduce soil erosion. For these collective functions, whitebark pine is considered both a keystone species for promoting community diversity and a foundation species for promoting community stability (Tomback et al. 2001; Schwandt 2006; Keane et al. 2012). As an important ecosystem component that influences the success of other organisms, it plays a vital role in colonizing areas disturbed by fire or landslides, stabilizing the soil, moderating snow melt, and providing the cover that allows regeneration of other tree species. Seed dissemination by whitebark pine is unique among American pines. The large, wingless seeds of the species are rarely if ever effectively spread by wind or gravity. Instead, whitebark pine seeds are mostly released from cones and disseminated by a bird species, the Clark’s nutcracker (*Nucifraga columbiana*). Many other wildlife species of high-elevation ecosystems depend to varying degrees on whitebark pine seeds as food resources. Two species of squirrels, the red squirrel and the Douglas squirrel, harvest large numbers of whitebark pine cones in good seed years and store them in midden piles for winter food (Mattson, et al. 2001).

Whitebark pine has a limited distribution within the Blue Mountains and is strongly associated with higher elevation areas within the cold forest potential vegetation group and within wilderness areas. Based on Forest Service vegetation databases, the Wallowa-Whitman National Forest contains the largest acreage of whitebark pine, with the Umatilla and Malheur National Forests containing smaller extents. Whitebark pine was found on approximately 140 of the 10,000 current vegetation survey plots. Locations of whitebark pine include the Eagle Cap Wilderness, the Elkhorn Mountains, areas near the Strawberry Wilderness, and Hells Canyon (Seven Devils Mountains).

The four major threats to whitebark pine populations within the Blue Mountains are white pine blister rust, mountain pine beetle, fire, and climate change (Aubry et al. 2008). Monitoring transects within the Blue Mountains analysis area indicate white pine blister rust infection within the majority of checked sites, with higher levels of infection in the Elkhorn Mountains, compared

to the Wallowa Mountains. Increased levels of whitebark pine mortality may alter high-elevation community composition and ecosystem processes similarly to what has been seen in other areas of the western United States (Keane et al. 2012).

Forest Stand Density

Stand density refers to the degree to which an area is occupied by trees and, hence the intensity by which trees are competing for site resources (Tappeiner 2007). Stand density is important as it directly relates to the availability of limited resources that are critical in terms of both stand-level productivity and individual tree vigor. It is also important in terms of wildfire behavior, wildlife habitat and insect/disease disturbance. For example, very high stand density tends to spread the limited available growing space and resources among many individual trees. The result is that some trees become stressed and decline in vigor. Stress also reduces the ability of a tree to resist insects and diseases and increases the likelihood of mortality. As stands of a given tree size reach certain thresholds of overall density, they essentially enter a zone of imminent competition-related mortality (Drew and Flewelling 1977, 1979). However, some wildlife species depend on the relative security of either dense stems and foliage or interlocking overstory canopies to rear young and/or to escape predators. Stand density relationships to potential fire behavior can be complex, but higher density forest stands typically correlate with greater potential for severe fire behavior because they provide more fuels, which are arranged in a more continuous manner.

Stand density can be described or quantified in many ways, but strictly speaking, it is an absolute measure of tree occupancy per unit area, like trees per acre or basal area per acre. Relative density is another concept that is important to forest managers, as it is used to gauge the degree of inter-tree competition relative to some implied biological limit or “carrying capacity” (Kimmins 2004). The broad-scale analysis and modeling done in support of this forest plan revision used canopy cover as a surrogate to characterize stand density. Canopy cover is somewhat different from stand density, as it is the proportion of the ground covered by a vertical projection of the tree canopy (Jennings et al. 1999). Tree size and numbers are not a direct part of this measure, but canopy cover generally correlates with the idea of relative site occupancy. It has the added advantage of being readily estimated by remote sensing techniques used in large-scale forest inventories. Canopy cover can also be indirectly estimated using attributes commonly collected during detailed ground examinations. Within the dry upland forest potential vegetation group, closed canopy/high stand density stands were defined as those having 40 percent canopy cover or greater. Within the moist and cold upland forest potential vegetation groups, closed canopy/high stand density was defined as those stands having 60 percent canopy cover or greater. Stands with canopy covers less than these thresholds were categorized as being “open” or having low density.

Table 272 compares the existing forest stand density as a percent of each upland forest potential vegetation group to the stand density distribution within the historical range of variability. Prior to Euro-American settlement dry upland forests of the Northwest like the ones found in the Blue Mountains region were burned by frequent low- or mixed-severity fires. The result was that these fires, which burned mostly on the surface, maintained relatively low tree density stand conditions throughout most of the dry upland forest (Hessburg et al. 2005). The estimate of the historical range of variability is that 80 to 90 percent of the dry upland forest would be expected to exist in open, low-density conditions if natural disturbance regimes and ecological processes were functioning. On the other hand, the moist and cold upland landscapes likely consisted of a high proportion of high-density stands, but a portion of those potential vegetation groups would also have likely existed in a low-density condition.

Table 272. Existing stand density as a percent of each upland forest potential vegetation group compared to the historical range of variability

Upland Forest Potential Vegetation Group and Stand Density	Historical Range of Variability (Desired Conditions)	Malheur	Umatilla	Wallowa-Whitman
Cold** Upland Forest Low Density	20% - 30%	88%	44%	62%
Cold** Upland Forest High Density	65% - 80%	12%	56%	38%
Moist** Upland Forest Low Density	30% - 40%	58%	55%	41%
Moist** Upland Forest High Density	60% - 80%	42%	45%	59%
Dry* Upland Forest Low Density	80% - 90%	60%	30%	32%
Dry* Upland Forest High Density	5% - 20%	40%	70%	67%

* Dry upland forest high density is approximately 40 percent canopy cover or greater.

** Cold and moist upland forest high density is approximately 60 percent canopy cover or greater.

Decades of wildfire suppression and exclusion, domestic livestock grazing, and timber harvesting have interacted to alter the structure, composition, and disturbance regimes of the Forests. In particular, the dry upland forest has become much denser. The vast majority of the Umatilla and Wallowa-Whitman's dry upland forest is uncharacteristically dense. The Malheur National Forest is in better condition in relation to the historical range of variability, but still has a significant surplus of dense dry forest stands. These results are consistent with results of a regional study compiled by Stine et al. (2014). That report indicated that current trees per acre density of the dry forest in northeast Oregon is on average roughly 2.5 times as high as they were historically. The same study showed that within the moist mixed-conifer forest trees per acre are about two times as high.

The current excess of over-stocked dry upland forest stands, combined with the imbalances in structural stages and species compositions already discussed, means the existing dry upland forests no longer appear or function as they once did. Large landscapes of dry forest are now more uniform in terms of their species composition and densities, and they are dominated by atypical dense, multi-layered structures. Stand density, structure, and species composition are all important factors related to potential fire behavior (Agee & Skinner 2005). With a large proportion of the dry upland forest currently altered in density and structure, and also lacking their historical representation of fire resistant species and older individual trees, the present condition of large areas of the dry upland forest now supports unusually severe wildfire behavior. A high-severity fire regime within the current dry upland forest is more likely to "reset" large areas into the stand initiation stage, or convert stands to shrublands and grasslands, than it is to allow future development into the desired mature, fire resistant old single-storied forest structures.

Climate Change Context

Climate change is expected to profoundly alter vegetation structure and composition, terrestrial ecosystem processes, and the delivery of important ecosystem services over the next century. Historically, the climate of the Blue Mountains region has fluctuated between cool and warm periods. Climate is affected by multiple factors, including sea surface temperatures tracked by indices such as the Pacific decadal oscillation, El Niño southern oscillation, and the Atlantic multi-decadal oscillation. Considerable natural variation in climate occurred historically and will continue. Different climate models project differing rates of change in temperature and precipitation because they operate at different scales, have different climate sensitivities, and

incorporate feedbacks differently. However, climate models are in agreement in projecting increasing average annual temperatures over the coming decades. Continued and/or increasing drought will also likely further affect the carrying capacity of forested sites, resulting in altered composition, structure, or even lifeforms (grass/shrub versus forest vegetation) especially on low elevation sites (Vose et al. 2016).

Since 1750, atmospheric carbon dioxide concentrations have increased from 280 to over 390 parts per million (ppm) and are expected to continue rising, reaching 450 to 875 ppm by 2100. Global mean temperatures have increased by about 1.3 degrees Fahrenheit over the past century and could increase by another 3.6 to 7.2 degrees Fahrenheit by 2100 as a result of increasing atmospheric concentrations of carbon dioxide and other greenhouse gases. Globally, mean annual precipitation is expected to increase somewhat, but there is great uncertainty about precipitation changes for any particular region, including the Pacific Northwest. Temperature and precipitation changes are expected to alter soil water availability by altering amounts and timing of precipitation, snowpack dynamics, and evapotranspiration rates (Peterson et al. 2014).

Climatic variability and change can affect plant physiological processes, including altering growth and reproductive phenology, rates of photosynthesis and respiration, root and shoot growth, and seed production. Elevated carbon dioxide can influence many of these same processes, either enhancing or offsetting climatic influences (Peterson et al. 2014). Climate influences the spatial distribution of major vegetation types, as well as the abundance of species and communities and the geographic ranges of individual species. Climate influences the rates at which terrestrial ecosystems process water, carbon, and nutrients and deliver ecosystem services like fresh water, food, and forest products. Climate also influences the disturbance processes that shape forest vegetation structure and composition, and altered disturbance regimes will likely be a very important catalyst for vegetation change in the future (Halofsky and Peterson 2017).

At broad scales, forests of western North America can generally be sorted into either “energy-limited” or “water-limited” systems. In water-limited forests, the primary factor limiting tree growth and productivity is competition for water. In energy-limited forests, water is sufficiently available, so the main factors limiting growth and productivity of individual trees are a combination of sunlight and temperature. Tree growth in energy-limited forests appears to be responding positively to warming temperatures over the past 100 years (McKenzie et al. 2001). Tree growth in energy-limited portions of the landscape (high elevations, north aspects) may increase as the climate warms and snowpack decreases, whereas tree growth in water-limited portions of the landscape (low elevations, south aspects) will probably decrease.

Some species may respond positively to higher concentrations of ambient carbon dioxide as a result of increased water-use efficiency, although this “fertilization” effect may diminish as other factors become limiting (Halofsky and Peterson 2017). Considerable uncertainty exists about how climate change will affect species distribution, forest productivity, and ecological disturbance in the Blue Mountains. Because the future climate may differ considerably from what has been observed in the past, it is difficult to project vegetative response accurately for specific locations and time periods.

Cold Upland Forest Potential Vegetation Group Projected Changes

The cold upland forest potential vegetation group is a high-elevation energy-limited forest ecosystem. Productivity is projected to increase in subalpine and alpine zones across the Pacific Northwest in response to moderate warming and elevated atmospheric carbon dioxide (Halofsky and Peterson 2017). Longer growing seasons and warmer summer temperatures associated with

projected future warming may promote increased tree growth within the treeline areas. Others, (Zald et al. 2012) point out that the importance of snow, the mediation of snow by interacting and context dependent factors in complex mountain terrain, and the uncertainty of climate change impacts on snow, make it difficult to understand how these areas may respond to future climate conditions.

Species distribution modelling completed for Halofsky and Peterson (2017) project that suitable climate available for most cold upland tree species will be either moderately reduced or nonexistent in the Blue Mountains by the end of the 21st century. Based on this model output, cold upland forests may be vulnerable to climate change, and high-elevation mountains (like the Wallowa Mountains and Seven Devils) may serve as refugia for subalpine species. Devine et al. (2012) considered subalpine fir, Engelmann spruce, and western white to be highly susceptible to climate change, although lodgepole pine has a lower susceptibility score. Although western white pine also has a high susceptibility score (Devine et al. 2012), its generalist life history (Rehfeldt et al. 1984) may confer phenotypic plasticity, allowing it to better adjust to changing environmental conditions. Although results from experimental and observational studies are not entirely clear, multiple lines of evidence suggest climate change is likely to produce significant changes in the cold upland forests over time, including altered growth and altered tree life cycle events. Cold upland forests may be converted to high-elevation herbaceous parklands or woodlands with ponderosa pine or Douglas-fir under warmer and drier scenarios. Remnant populations may persist in the highest of elevations within the Blue Mountains (such as the Wallowa Mountains). Increased wildfire may constrain tree reestablishment in these slow-growing systems, particularly for sites without serotinous lodgepole pine as a common, pre-fire component. Increased insect and disease activity with climate change may also increase stress and mortality in these cold upland forests (Halofsky and Peterson 2017).

Moist Upland Forest Potential Vegetation Group Projected Changes

Many (but not all) productive moist upland forests at higher elevation are more energy limited than water limited. Moderate warming along with increased atmospheric carbon dioxide may lead to a positive response and increased productivity within some of these moist upland forests. However, in the Blue Mountains, lower elevation moist upland forests may transition to being primarily water-limited, particularly areas without much ash or loess, which would enhance water holding capacity. More extreme warming and increased drought stress, particularly at lower elevations and in the southern portion of the Blue Mountains (Malheur National Forest) will likely cause decreased tree growth and forest productivity in these areas of the moist upland forest. However, suitable climate habitat currently occupied by cold upland forests may offset these losses (Halofsky and Peterson 2017).

Paleoecological and some model evidence suggest that climate change will cause moderate to extreme loss of moist upland forests and characteristic species throughout the Blue Mountains national forests. However, some model results do suggest the opposite. Future warming with increased precipitation may lead to increased importance of this potential vegetation group across the landscape. This outcome is somewhat supported by recent trends in response to warming in energy limited forests. Unlike cold upland forests, these forests may be able to adapt to future climate change by expanding into new available habitats. Warm and very warm moist forest plant associations may be able to better adapt to warming compared to cooler plant associations within the moist upland forest potential vegetation group. However, increased summer drought stress may make these forests more vulnerable to other stressors, particularly at lower elevations and on southern sites in the Blue Mountains. Wildfire activity and insect and disease outbreaks will most

likely increase with future warming, and may reduce the distribution of this potential vegetation group (Halofsky and Peterson 2017).

Dry Upland Forest Potential Vegetation Group Projected Changes

Dry upland forests in the Blue Mountains are water-limited, and productivity is projected to decline in a warmer climate (Latta et al. 2010). Water stress during the warm season is the primary factor limiting tree growth at low elevations common in the dry upland forest potential vegetation group, and negative water balances constrain photosynthesis, although this may be partially offset if carbon dioxide fertilization significantly increases water-use efficiency in trees. Generally, increased drought stress will likely result in decreased tree growth and forest productivity in the dry upland forests of the Blue Mountains. Areas with increased tree density due to recent fire exclusion may be particularly vulnerable to future climate change because of increased drought stress, although suitable climate habitat currently occupied by moist upland forest may offset these potential losses (Halofsky and Peterson 2017).

Some areas of the dry upland forest potential vegetation group may undergo undesirable changes in the face of future climate change. These forests have already experienced a long history of human land use. Many dry upland forests are already experiencing severe and uncharacteristic wildfire, and equally atypical insect and disease outbreaks, which will most likely increase in the future. It is likely that the hottest and driest sites will shift to woodland or steppe vegetation. Species characteristic of hot dry plant associations may be better adapted to future conditions and these species may become more common. Some model output suggests that Douglas-fir and ponderosa pine may decrease in the future, although paleoecological evidence conflicts somewhat with this conclusion, suggesting that ponderosa pine was able to adapt to warmer climate by migrating north or up in elevation. However, the extent to which these species can adapt under current and future stressors is unclear. The overall vulnerability assessment score for ponderosa pine is quite low, whereas Douglas-fir has a somewhat higher score. Given the strong paleoecological evidence regarding the persistence of ponderosa pine, coupled with its potential low vulnerability and availability of habitat currently occupied by moist forests, it is likely that this forest type will persist and remain an important component of the landscape, although shifts in the distribution of dry upland forests and changes in relative abundance of different plant associations might be expected (or the formation of novel plant associations) (Halofsky and Peterson 2017).

Forest Vegetation – Environmental Consequences

Key Indicators of the Alternatives' Effects to Forest Vegetation:

Indicator: Percent of upland forest potential vegetation groups in each forest structural stage at year 20 and year 50.

Indicator: Percent of upland forest potential vegetation groups in each species composition group at year 20 and year 50.

Indicator: Percent of upland forest potential vegetation groups in low or high density conditions at year 20 and year 50.

Effects from Each Alternative

Forest structural stages, species composition and stand density can all be changed through a variety of mechanisms, such as natural disturbances (like insects, disease, fire, or storms) growth

and succession and management activities (such as timber harvest or fire suppression). The following section describes the expected changes in forest vegetation based on both natural and human actions for each of the alternatives. The landscape composition of these various forest characteristics can have an effect on ecological resiliency. For example, a landscape that contains a diversity of structural stages would be more sustainable and able to perpetuate itself through time because, as older age classes succumb to mortality, younger age classes would be available to replace them. A landscape that consists of a diversity of diameter classes would also be at decreased risk of attack from bark beetles that favor certain diameter classes. The alternatives that result in the closest achievement of the desired conditions for forest structural stages, species composition and stand density would likely result in forest conditions that are more ecologically resilient. By maintaining and/or restoring forest conditions similar to that which occurred and evolved prior to interruption of the historical fire regime (the historical range of variability), ecosystems would be better able to absorb disturbances while retaining the same basic structure and ways of functioning, and they would have a greater capacity to adapt to stress and change in the future.

In order to compare the effectiveness of each of the alternatives in achieving the desired conditions for forest structural stages, species composition and stand density, the amount of variation (either above or below) from the desired condition ranges was determined for each of the individual stages or classes. The amount of variation for each of the structural stages or classes was then added together to obtain a summed total amount of variation for each alternative. All variation values were treated as positive numbers, regardless of whether the stage or class fell above or below the desired condition range. If a value fell within the desired condition range, then there was no variation and a value of zero was assigned. For those stages or classes that are outside of the desired condition ranges, the amount of variation for each was added together to obtain a summed total for each alternative. This same method was used to compare the effectiveness of each of the alternatives in achieving the desired conditions for structural stages, stand density and species composition.

Using the structural stages of the Malheur’s cold upland forest potential vegetation group as an example, Alternative A would result in 33 percent of the potential vegetation group in the stand initiation stage, 14 percent in the stem exclusion stage, 30 percent in the understory reinitiation stage, 6 percent in the old forest single-story stage, and 17 percent in the old forest multi-story stage at year 50 (see Table 273). The desired condition ranges for each structural stage are also displayed in the table. Under Alternative A, the percent of the Malheur’s cold upland forest in the stand initiation stage (33 percent) would be within the desired condition range at year 50, so the variation is zero. The percent of the potential vegetation group in the stem exclusion stage (14 percent) would vary from the desired condition range (15 to 30 percent) by 1 percentage point at year 50. The percent in the understory reinitiation stage (30 percent) would vary from the desired condition range (10 to 25 percent) by 5 percentage points at year 50. The percent in the old forest single-story stage and old forest multi-story stages would both be within their desired condition ranges at year 50, so the variation for those stages is zero. So in this example, under Alternative A, the projected percent of the cold upland forest potential vegetation group in each of the forest structural stages would vary from the desired condition ranges by a summed total of approximately 6 percentage points (1 + 5) at year 50.

Summary of Direct Effects

The detailed analysis following this summary section provides a comprehensive look at all the individual forest vegetation indicators, and a description of how each alternative is expected to

change the forest vegetation in terms of the desired conditions. All three of the major forest potential vegetation groups are analyzed and discussed below, but this effects summary focuses mainly on changes to three key areas of the dry upland forest potential vegetation group in particular. The dry upland forest is the dominant and most widely distributed forest vegetation group among the National Forests, and it is also the most highly departed from the desired conditions. It also plays a major role in terms of the key issues of Ecological Resilience and Old Forests (related discussion can be found within those sections of Chapter 3).

After comparing existing conditions to the desired conditions, it is apparent that two of the most significant concerns in regards to the dry upland forest vegetation are related to the distribution structural stages. Currently, there is a vast surplus of understory reinitiation stages as compared to the desired conditions, and also a very large deficit of old forest single story stages. Stand density is the third major issue, with a substantial excess of high-density stand conditions and a corresponding lack of low-density, open forest conditions found across the dry uplands of the Blue Mountains national forests. This summary will focus on how quickly the alternatives could move these current conditions toward the desired conditions, and how well they would be able to keep them there.

The detailed data presented in the following sections show that even if fully implemented, none of the alternatives would be able to completely correct all imbalances and restore the forest potential vegetation groups to the desired conditions within the next planning period, or even within the mid-term period of 50 years. Time itself is a key component of the overall restoration solution, particularly in regards to correcting the current scarcity of desired resilient old forest structural stages within the dry upland forest. However, well designed management strategies can do a lot in the near term to address immediate issues, move toward the historical range of variation, and reduce current risk levels. Thinning activities within the dense portions of the dry upland forests understory reinitiation stages within the short and mid-term timeframe should promote a general stabilizing effect across the dry upland landscapes, which will allow continued beneficial development into older structural stages to occur over time. Compared to the other alternatives, the data tables in the following section show that Alternatives D, E-Modified, and E-Modified Departure make the most progress reducing the surpluses of understory reinitiation and dense forest, while simultaneously increasing the proportions of old forest single-storied stages.

Alternative E-Modified Departure would represent the most rapid change in terms of reducing the surplus of understory reinitiation stages and overly dense dry upland forests over the a 20-year time frame, with accelerated levels of harvesting focused on the dry upland forest. However, in subsequent decades, the amount of restoration related harvesting work under E-Modified Departure would decline markedly as the timber harvest schedule returns to a level that can produce non-declining volume flows over the long-term (see Timber and Forest Products section). This inevitable decline in treatment levels associated with Alternative E-Modified Departure is likely part of the reason that when looking at the same metrics at the 50-year time frame, the alternative does not perform significantly better than Alternatives D or E-Modified. In terms of restoring the single-storied old forest of the dry upland forests, Alternatives E-Modified and E-Modified Departure are the best options among all of the alternatives, and their rates of progress would be virtually identical at the 50-year time frame.

Although Alternatives D is among the top three performing alternatives in terms of moving toward these desired conditions quickly, its lack of flexibility in regards to using wildland fire as a management tool may hinder its ability to maintain the desired conditions of the dry upland forest over time. Historically wildland fire played a particularly critical role within the forests of

the Blue Mountains in terms of maintaining forest vegetation within the historical range of variation. As dense understory reinitiation stages of the dry upland forest are moved into lower density forms of the stem exclusion stage by means such as harvesting, wildland fire would be a useful tool in terms of maintaining those conditions and thus allowing those stands to develop into need old forest single-storied stages. Alternatives E-Modified and E-Modified Departure both would not only focus mechanical treatments on the forest conditions with the most critical needs, but they would also include a much broader flexibility to use both planned ignitions and managed wildfire to aid in the maintenance of desired structures and restoration of key ecosystem processes. These tools would be a great aid in maintaining and enhancing the desired attributes of these fire adapted forests over time. Therefore, as compared to Alternative D, either Alternative E-Modified or E-Modified Departure may result in greater realization of the desired conditions throughout the dry upland forest.

Table 273. Forest structural stages, as a percent of the cold upland forest potential vegetation group (with amount of variation from the desired condition range in parentheses) by alternative within the Malheur National Forest

Alternative	Time Period	Cold/SI DC = 20% – 45%	Cold/SE DC = 15% - 30%	Cold/UR DC = 10% - 25%	Cold/OFSS DC = 5% - 20%	Cold/OFMS DC = 10% - 25%	Summed Total Amount of Variation
Not applicable	Existing Condition	24% (0)	12% (3)	44% (19)	1% (4)	20% **(0)**	**(26)**
Alt. E-Modified	Year 20	26% (0)	16% (0)	31% (6)	3% (2)	24 (0)	**(8)**
Alt. E-Modified	Year 50	30% (0)	16 (0)	29% (4)	6% (0)	19% (0)	**(4)**
Alt. E-Modified Departure	Year 20	26% (0)	16% (0)	31% (6)	3% (2)	24 (0)	**(8)**
Alt. E-Modified Departure	Year 50	30% (0)	16 (0)	29% (4)	6% (0)	19% (0)	**(4)**
Alt. F	Year 20	25% (0)	18% (0)	28% (3)	4% (1)	24% (0)	**(4)**
Alt F.	Year 50	42% (0)	13% (2)	25% (0)	5% (0)	14% (0)	**(2)**
Alt. E	Year 20	26% (0)	19% (0)	28% (3)	4% (1)	23% (0)	**(4)**
Alt. E	Year 50	46% (1)	14% (1)	22% (0)	5% (0)	13% (0)	**(2)**
Alt. D	Year 20	28% (0)	19% (0)	27% (2)	3% (2)	22% (0)	**(4)**
Alt. D	Year 50	48% (3)	15% (0)	21% (0)	5% (0)	12% (0)	**(3)**
Alt. C	Year 20	23% (0)	19% (0)	30% (5)	4% (1)	24% (0)	**(6)**
Alt. C	Year 50	36% (0)	13% (2)	29% (4)	7% (0)	16% (0)	**(6)**
Alt. B	Year 20	23% (0)	18% (0)	29% (4)	4% (1)	26% (1)	**(6)**
Alt. B	Year 50	37% (0)	13% (2)	28% (3)	6% (0)	17% (0)	**(5)**
Alt. A	Year 20	22% (0)	19% (0)	30% (5)	3% (2)	26% (1)	**(8)**
Alt. A	Year 50	33% (0)	14% (1)	30% (5)	6% (0)	17% (0)	**(6)**

DC = desired condition; SI = stand initiation; SE = stem exclusion; UR = understory reinitiation; OFSS = old forest single story; OFMS = old forest multi-story

Forest Structural Stages

Malheur National Forest – Structural Stages of the Cold Upland Forest

The cold upland forest makes up a very small portion of the Malheur's forest landscape. The largest current deviation from desired conditions is in terms of a significant surplus of understory reinitiation stages. All of the alternatives make substantial improvements in terms of reducing the

understory reinitiation stages toward the historical range of variability, and Alternatives D, E and F are estimated to be within the historical range by year 50. In terms of the total variation within the Malheur's cold upland forest, again Alternatives D, E, and F all would likely result in conditions closest to the historical range of variability at both the 20-year and 50-year time frames. All of the other alternatives would also substantially reduce the existing condition's 26-point total variation. Relatively modest levels of active management were scheduled within the cold upland forest, so the similar results across alternatives may be driven largely by natural disturbance effects.

Malheur National Forest – Structural Stages of the Dry Upland Forest

The dry upland forest makes up the vast majority of the Malheur's forest landscape. With the existing condition showing a total variation from the historical range of variability of 100, it is also the most highly departed of all the potential vegetation groups from the desired conditions. The largest current deviations are in terms of a very large surplus of understory reinitiation stages and a lack of old forest single-story stages. With their very ambitious objectives for thinning harvests, Alternatives D and E-Modified Departure would likely make the most progress toward the desired conditions in the 20-year timeframe (Table 274). These two alternatives would reduce the total variation from desired conditions to about 71 to 72 within 20 years. Alternatives E and E-Modified would be the next best options in the near term, as they would drop the dry upland forest's variation to 75 to 77. Despite some indicated differences in near term performance, all four of these alternatives are likely to result in similar levels of progress over the mid-term 50-year horizon. All four alternatives would cut the potential vegetation group's current variation basically in half over the 50-year time frame, to levels of 47 to 50.

The total summed variation as an indicator may tend to miss some of the significance in terms of the changes expected within the dry upland forest. The alternatives that are more aggressive with active restoration would thin a large amount of what is now understory reinitiation stage, and thus it would be reclassified as stem exclusion stages. In the near term, when looking just at total variation as a metric, this merely results in a swap of a large variation in the understory reinitiation stages for a corresponding large variation in stem exclusion stages. What is missed in terms of the variation scoring is that the stem exclusion stages of the dry upland forest would likely represent a much more stable condition, less prone to atypical severe wildfire. The stem exclusion stages would also be poised to develop directly into future old forest single-story stages that are currently lacking. The understory reinitiation stages are very vulnerable to excessive fire behaviors, and in the absence of severe fire, they are likely to eventually develop into old forest multi-story stages, which are already overrepresented on the landscape. Alternatives E, E-Modified and E-Modified Departure, which reduce the understory reinitiation stages the most, may be superior for the Malheur National Forest in light of these considerations.

Alternatives A, B and C would be the least effective alternatives in achieving the desired conditions for structural stages in the Malheur's dry upland forest potential vegetation group. Under Alternatives A, B and C, the percent of the dry upland forest potential vegetation group in each of the structural stages would vary from the desired condition ranges by a summed total of approximately 84 to 87 points after 20 years. These trends of lagging performance would continue into the 50-year time frame with total variations from desired conditions expected to remain around 67 to 74.

Table 274. Forest structural stages, as a percent of the dry upland forest potential vegetation group (with amount of variation from the desired condition range in parentheses) by alternative within the Malheur National Forest

Alternative	Time Period	Dry/SI DC = 15% – 30%	Dry/SE DC = 10% - 20%	Dry/UR DC = < 5%	Dry/OFSS DC = 40% - 65%	Dry/OFMS DC = 1% - 15%	Summed Total Amount of Variation
Not applicable	Existing Condition	6% (9)	18% (0)	54% (49)	3% (37)	20% (5)	**(100)**
Alt. E-Modified	Year 20	10% (5)	35% (15)	27% (22)	9% (31)	19% (4)	**(77)**
Alt. E-Modified	Year 50	14% (1)	35% 15	17% 12	19% (21)	15% (0)	**(49)**
Alt. E-Modified Departure	Year 20	10% (5)	41% (21)	20% (15)	12% (28)	17% (2)	**(71)**
Alt. E-Modified Departure	Year 50	14% (1)	36% 16	15% (10)	20% (20)	15% (0)	**(47)**
Alt. F	Year 20	10% (5)	29% (9)	33% (28)	7% (33)	21% (6)	**(81)**
Alt. F	Year 50	16% (0)	31% (11)	23% (18)	12% (28)	19% (4)	**(61)**
Alt. E	Year 20	12% (3)	33% (13)	28% (23)	8% (32)	19% (4)	**(75)**
Alt. E	Year 50	18% (0)	35% (15)	16% (11)	16% (24)	15% (0)	**(50)**
Alt. D	Year 20	12% (3)	25% (5)	36% (31)	10% (30)	18% (3)	**(72)**
Alt. D	Year 50	19% (0)	29% (9)	20% (15)	16% (24)	16% (1)	**(49)**
Alt. C	Year 20	9% (6)	27% (7)	36% (31)	6% (34)	22% (7)	**(85)**
Alt. C	Year 50	13% (2)	28% (8)	28% (23)	10% (30)	22% (7)	**(70)**
Alt. B	Year 20	10% (5)	28% (8)	35% (30)	6% (34)	22% (7)	**(84)**
Alt. B	Year 50	14% (1)	29% (9)	35% (30)	11% (29)	20% (5)	**(74)**
Alt. A	Year 20	7% (8)	29% (9)	35% (30)	7% (33)	22% (7)	**(87)**
Alt. A	Year 50	11% (4)	30% (10)	26% (21)	13% (27)	20% (5)	**(67)**

DC = desired condition; SI = stand initiation; SE = stem exclusion; UR = understory reinitiation; OFSS = old forest single story; OFMS = old forest multi-story

Malheur National Forest – Structural Stages of the Moist Upland Forest

Like the cold upland forest, the Malheur's moist upland forest is a relatively minor component of the overall forested landscape. With the existing condition showing a total variation from the historical range of variability of 82 points, it is currently highly departed from the desired conditions. The largest deviations are in terms of surplus understory reinitiation and old forest multi-story stages and lacking stand initiation and stem exclusion stages. Alternatives D, E-Modified and E-Modified Departure would be likely to make the most progress toward the desired conditions in the 20-year timeframe. These alternatives would reduce the total variation from desired conditions to about 59 to 61 within 20 years. Looking out to the 50-year timeframe shows Alternative D as the best performing option, with the total variation from desired conditions reduced to about 28 points after five decades. In comparison, Alternatives E-Modified and E-Modified Departure would likely result in total variation of 39 to 40 points within the same timeframe.

Alternative A stands out as being the least effective alternative in achieving the structural desired conditions for the Malheur's moist upland forest potential vegetation group. Under Alternative A, almost no improvement is indicated, as the structural stages would still vary from the desired condition ranges by a summed total of approximately 79 points after 20 years. These trends of relatively weak performance continue into the 50-year time frame, but Alternatives B and C

actually have the worst expected level of improvement after 50 years with total variations from desired conditions expected to remain around 58 to 59.

Table 275. Forest structural stages, as a percent of the moist upland forest potential vegetation group (with amount of variation from the desired condition range in parentheses) by alternative within the Malheur National Forest

Alternative	Time Period	Moist/SI DC = 20% – 30%	Moist /SE DC = 20% - 30%	Moist /UR DC = 15% - 25%	Moist /OFSS DC = 10% - 20%	Moist /OFMS DC = 15% - 20%	Summed Total Amount of Variation
Not applicable	Existing Condition	1% (19)	5% (15)	41% (16)	5% (5)	47% (27)	**(82)**
Alt. E-Modified	Year 20	11% (9)	7% (13)	36% (11)	5% (5)	41% (21)	**(59)**
Alt. E-Modified	Year 50	19% (1)	10% (10)	37% (12)	4% (6)	30% (10)	**(39)**
Alt. E-Modified Departure	Year 20	11% (9)	6% (14)	37% (12)	5% (5)	41% (21)	**(61)**
Alt. E-Modified Departure	Year 50	21% (2)	8% (10)	37% (12)	4% (6)	30% (10)	**(40)**
Alt. F	Year 20	4% (16)	8% (12)	36% (11)	6% (4)	47% (27)	**(70)**
Alt F.	Year 50	12% (8)	9% (11)	40% (15)	6% (4)	33% (13)	**(51)**
Alt. E	Year 20	6% (14)	8% (12)	34% (9)	6% (4)	46% (26)	**(65)**
Alt. E	Year 50	16% (4)	11% (9)	36% (11)	6% (4)	31% (11)	**(39)**
Alt. D	Year 20	8% (12)	9% (11)	33% (8)	6% (4)	44% (24)	**(59)**
Alt. D	Year 50	20% (0)	13% (7)	32% (7)	6% (4)	30% (10)	**(28)**
Alt. C	Year 20	4% (16)	7% (13)	36% (11)	6% (4)	47% (27)	**(71)**
Alt. C	Year 50	9% (11)	9% (11)	43% (18)	6% (4)	35% (15)	**(59)**
Alt. B	Year 20	4% (16)	8% (12)	35% (10)	6% (4)	47% (27)	**(69)**
Alt. B	Year 50	9% (11)	9% (11)	41% (16)	5% (5)	35% (15)	**(58)**
Alt. A	Year 20	3% (17)	0% (20)	36% (11)	6% (4)	47% (27)	**(79)**
Alt. A	Year 50	7% (13)	11% (9)	41% (16)	7% (3)	34% (14)	**(55)**

DC = desired condition; SI = stand initiation; SE = stem exclusion; UR = understory reinitiation; OFSS = old forest single story; OFMS = old forest multi-story

Umatilla National Forest – Structural Stages of the Cold Upland Forest

The cold upland forest makes up a very small portion of the Umatilla's forest landscape, and much of the cold upland forest potential vegetation group is located within existing or proposed wilderness, roadless or backcountry areas. In terms of its current condition, the cold upland forest is slightly overrepresented in the old forest multi-story stages, but is otherwise fairly close to being within the desired condition ranges. All of the alternatives make similar improvements in balancing the old forest stages between old forest multi-story and old forest single story. Similarly, all of the alternatives except Alternative D seem able to achieve desired conditions within 50 years. Alternative D ends up with a small excess of the stand initiation stages after 50 years. This may be caused by the higher level of regeneration harvesting proposed under Alternative D. Relatively modest levels of active management were scheduled within the cold upland forest, so the similar results across alternatives may be driven largely by natural disturbance effects.

Table 276. Forest structural stages, as a percent of the cold upland forest potential vegetation group (with amount of variation from the desired condition range in parentheses) by alternative within the Umatilla National Forest

Alternative	Time Period	Cold/SI DC = 20% – 45%	Cold/SE DC = 15% - 30%	Cold/UR DC = 10% - 25%	Cold/OFSS DC = 5% - 20%	Cold/OFMS DC = 10% - 25%	Summed Total Amount of Variation
Not applicable	Existing Condition	30% (0)	21% (0)	18% (0)	0% (5)	30% (5)	**(10)**
Alt. E-Modified	Year 20	33% (0)	26% (0)	20% (0)	2% (3)	19% (0)	**(3)**
Alt. E-Modified	Year 50	40% (0)	22% (0)	19% (0)	7% (0)	12% (0)	**(0)**
Alt. E-Modified Departure	Year 20	35% (0)	26% (0)	19% (0)	1% (4)	19% (0)	**(4)**
Alt. E-Modified Departure	Year 50	40% (0)	22% (0)	19% (0)	7% (0)	12% (0)	**(0)**
Alt. F	Year 20	29% (0)	31% (1)	20% (0)	2% (3)	19% (0)	**(4)**
Alt F.	Year 50	46% (1)	19% (0)	18% (0)	7% (0)	10% (0)	**(1)**
Alt. E	Year 20	35% (0)	27% (0)	18% (0)	2% (3)	18% (0)	**(3)**
Alt. E	Year 50	43% (0)	23% (0)	16% (0)	8% (0)	10% (0)	**(0)**
Alt. D	Year 20	31% (0)	31% (1)	18% (0)	2% (3)	18% (0)	**(4)**
Alt. D	Year 50	49% (4)	21% (0)	13% (0)	7% (0)	9% (1)	(5)
Alt. C	Year 20	28% (0)	31% (1)	20% (0)	2% (3)	19% (0)	**(4)**
Alt. C	Year 50	45% (0)	18% (0)	19% (0)	8% (0)	10% (0)	**(0)**
Alt. B	Year 20	28% (0)	31% (1)	20% (0)	2% (3)	19% (0)	**(4)**
Alt. B	Year 50	45% (0)	19% (0)	19% (0)	7% (0)	11% (0)	**(0)**
Alt. A	Year 20	28% (0)	31% (1)	20% (0)	2% (3)	20% (0)	**(4)**
Alt. A	Year 50	43% (0)	19% (0)	20% (0)	7% (0)	11% (0)	**(0)**

DC = desired condition; SI = stand initiation; SE = stem exclusion; UR = understory reinitiation; OFSS = old forest single story; OFMS = old forest multi-story

Umatilla National Forest - Structural Stages of the Dry Upland Forest

The dry upland forest makes up over half of the Umatilla's forest landscape. With the existing condition showing a total variation from the historical range of variability of 90, it is also the most highly departed of all the potential vegetation groups from the desired conditions. The most significant deviations currently are in terms of a very large surplus of understory reinitiation stages and a lack of old forest multi-story stages.

With their very ambitious objectives for thinning harvests, Alternatives D and E-Modified Departure would likely make the most progress toward the desired conditions in the 20-year timeframe. These two alternatives would reduce the total variation from desired conditions to about 72 to 74 within 20 years. Alternatives E and E-Modified would be the next best options in the near term, as they would drop the dry upland forest's variation to about 75. Alternative E-Modified and E-Modified Departure both indicate the best expected results over the 50-year time frame. Both of these alternatives would cut the potential vegetation groups current variation substantially over the 50-year time frame, to levels of 54 to 55.

Table 277. Forest structural stages, as a percent of the dry upland forest potential vegetation group (with amount of variation from the desired condition range in parentheses) by alternative within the Umatilla National Forest

Alternative	Time Period	Dry/SI DC = 15% – 30%	Dry /SE DC = 10% - 20%	Dry /UR DC = < 5%	Dry /OFSS DC = 40% - 65%	Dry /OFMS DC = 1% - 15%	Summed Total Amount of Variation
Not applicable	Existing Condition	12% (3)	26% (6)	50% (45)	4% (36)	8% (0)	**(90)**
Alt. E-Modified	Year 20	14% (1)	41% (21)	27% (22)	9% (31)	9% (0)	**(75)**
Alt. E-Modified	Year 50	17% (0)	43% (23)	15% (10)	18% (22)	7% (0)	**(55)**
Alt. E-Modified Departure	Year 20	13% (2)	49% (29)	19% (14)	11% (29)	8% (0)	**(74)**
Alt. E-Modified Departure	Year 50	16% (0)	44% (24)	14% (9)	19% (21)	7% (0)	**(54)**
Alt. F	Year 20	14% (1)	38% (18)	30% (25)	7% (33)	10% (0)	**(77)**
Alt F.	Year 50	18% (0)	40% (20)	19% (14)	13% (27)	9% (0)	**(61)**
Alt. E	Year 20	15% (0)	39% (19)	29% (24)	8% (32)	10% (0)	**(75)**
Alt. E	Year 50	19% (0)	42% (22)	16% (11)	14% (26)	9% (0)	**(59)**
Alt. D	Year 20	16% (0)	40% (20)	26% (21)	9% (31)	9% (0)	**(72)**
Alt. D	Year 50	21% (0)	41% (21)	16% (11)	14% (26)	8% (0)	**(58)**
Alt. C	Year 20	11% (4)	36% (16)	35% (30)	6% (34)	12% (0)	**(84)**
Alt. C	Year 50	14% (1)	38% (18)	25% (20)	11% (29)	12% (0)	**(68)**
Alt. B	Year 20	13% (2)	37% (17)	32% (27)	7% (33)	11% (0)	**(79)**
Alt. B	Year 50	17% (0)	40% (20)	21% (16)	12% (28)	10% (0)	**(64)**
Alt. A	Year 20	11% (4)	39% (19)	31% (26)	7% (33)	11% (0)	**(82)**
Alt. A	Year 50	12% (3)	41% (21)	21% (16)	15% (25)	10% (0)	**(65)**

DC = desired condition; SI = stand initiation; SE = stem exclusion; UR = understory reinitiation; OFSS = old forest single story; OFMS = old forest multi-story

The total summed variation as an indicator may tend to miss some of the significance in terms of the changes expected within the dry upland forest. The alternatives that are more aggressive with active restoration would thin a large amount of what is now understory reinitiation stage and thus it would be reclassified as stem exclusion stages. In the near term, when looking just at total variation as a metric, this merely results in a swap of a large variation in the understory reinitiation stages for a corresponding large variation in stem exclusion stages. What is missed in terms of the variation scoring is that the stem exclusion stages of the dry upland forest would likely represent a much more stable condition, less prone to atypical severe wildfire. The stem exclusion stages would also be poised to develop directly into future old forest single story stages, which are currently lacking. The understory reinitiation stages are very vulnerable to excessive fire behaviors, and in the absence of severe fire, they are likely to eventually develop into old forest multi-story stages, which are already overrepresented on the landscape. Alternatives D, E-Modified and E-Modified Departure, which reduce the understory reinitiation stages the most, may be superior for the Umatilla National Forest in light of these considerations.

Alternatives A, B and C would be the least effective alternatives in achieving the desired conditions for structural stages in the Umatilla's dry upland forest potential vegetation group. Under Alternatives A, B and C, the percent of the dry upland forest potential vegetation group in each of the structural stages would still be expected to vary from the desired condition ranges by a summed total of approximately 79 to 84 points after 20 years. These trends of relatively weak

performance continue into the 50-year time frame with total variations from desired conditions expected to remain around 64 to 68.

Umatilla National Forest – Structural Stages of the Moist Upland Forest

The Umatilla's moist upland forest component is significant, making up almost 40% of the overall forested landscape. With the existing condition showing a total variation from the historical range of variability of 37 points, it is not nearly as highly departed from the desired conditions as the dry upland forest potential vegetation group. The largest deviations are in terms of surplus old forest multi-story stages and lacking stand initiation and stem exclusion stages. Alternatives E and E-Modified Departure would likely make the most progress toward the desired conditions within the 20-year timeframe. These two alternatives would reduce the total variation from desired conditions to about 28 to 29 points within 20 years, though none of them would make any progress in reducing the excess of old forest multi-story stages. Looking out to the 50-year time frame shows Alternatives D and E as the best performing options with the total variation from desired conditions reduced to about 26 to 27 points after five decades. In comparison, the next best alternatives in the 50-year horizon, Alternatives F, E-Modified and E-Modified Departure would likely result in total variation of 30 to 31.

Table 278. Forest structural stages, as a percent of the moist upland forest potential vegetation group (with amount of variation from the desired condition range in parentheses) by alternative within the Umatilla National Forest

Alternative	Time Period	Moist/SI DC = 20% – 30%	Moist /SE DC = 20% - 30%	Moist /UR DC = 15% - 25%	Moist /OFSS DC = 10% - 20%	Moist /OFMS DC = 15% - 20%	Summed Total Amount of Variation
Not applicable	Existing Condition	9% (11)	10% (10)	26% (1)	23% (3)	32% (12)	(37)
Alt. E-Modified	Year 20	10% (10)	14% (6)	28% (3)	13% (0)	35% (15)	(34)
Alt. E-Modified	Year 50	14% (6)	16% (4)	34% (9)	7% (3)	29% (9)	(31)
Alt. E-Modified Departure	Year 20	12% (8)	15% (5)	25% (0)	13% (0)	35% (15)	(28)
Alt. E-Modified Departure	Year 50	16% (4)	15% (5)	34% (9)	6% (4)	29% (9)	(31)
Alt. F	Year 20	9% (11)	14% (6)	26% (1)	15% (0)	36% (16)	(34)
Alt F.	Year 50	12% (8)	16% (4)	34% (9)	9% (1)	28% (8)	(30)
Alt. E	Year 20	11% (9)	15% (5)	28% (3)	14% (0)	32% (12)	(29)
Alt. E	Year 50	13% (7)	18% (2)	33% (8)	8% (2)	28% (8)	(27)
Alt. D	Year 20	11% (9)	14% (6)	25% (0)	15% (0)	36% (16)	(31)
Alt. D	Year 50	17% (3)	20% (0)	8% (7)	28% (8)	28% (8)	(26)
Alt. C	Year 20	8% (12)	14% (6)	27% (2)	16% (0)	37% (17)	(37)
Alt. C	Year 50	9% (11)	16% (4)	37% (12)	10% (0)	29% (9)	(36)
Alt. B	Year 20	8% (12)	13% (7)	27% (2)	14% (0)	37% (17)	(38)
Alt. B	Year 50	11% (9)	16% (4)	36% (11)	8% (2)	29% (9)	(35)
Alt. A	Year 20	7% (13)	14% (6)	27% (2)	15% (0)	37% (17)	(38)
Alt. A	Year 50	8% (12)	18% (2)	36% (11)	9% (1)	29% (9)	(35)

DC = desired condition; SI = stand initiation; SE = stem exclusion; UR = understory reinitiation; OFSS = old forest single story; OFMS = old forest multi-story

All of these alternatives have fairly modest effects on the moist upland potential vegetation group. Since the moist upland forest is only moderately departed currently, and the highly departed dry upland forest represents a larger portion of the landscape, these results may not indicate a complete picture in terms of which alternative is likely to improve forest structure stages the best.

Alternatives A, B and C stand out as being the least effective alternatives in achieving the structural desired conditions for the Umatilla's moist upland forest. Under these three alternatives, no improvement is indicated, as the structural stages would still vary from the desired condition ranges by a summed total of approximately 37 to 38 points after 20 years. These trends of relatively weak performance continue into the 50-year time frame, with still virtually no improvement in overall potential vegetation group variation expected after 50.

Wallowa-Whitman National Forest – Structural Stages of the Cold Upland Forest

The cold upland forest makes up about one quarter of the Wallowa-Whitman's forest landscape, and much of the cold upland forest potential vegetation group is located within existing or proposed wilderness, roadless or backcountry areas.

Table 279. Forest structural stages, as a percent of the cold upland forest potential vegetation group (with amount of variation from the desired condition range in parentheses) by alternative within the Wallowa-Whitman National Forest

Alternative	Time Period	Cold/SI DC = 20% – 45%	Cold/SE DC = 15% - 30%	Cold/UR DC = 10% - 25%	Cold/OFSS DC = 5% - 20%	Cold/OFMS DC = 10% - 25%	Summed Total Amount of Variation
Not applicable	Existing Condition	14% (6)	10% (5)	41% (16)	1% (4)	34% (9)	**(40)**
Alt. E-Modified	Year 20	22% (0)	12% (3)	36% (11)	3% (2)	27% (2)	**(18)**
Alt. E-Modified	Year 50	31% (0)	11% (4)	32% (7)	5% (0)	21% (0)	**(11)**
Alt. E-Modified Departure	Year 20	22% (0)	12% (3)	36% (11)	3% (2)	27% (2)	**(18)**
Alt. E-Modified Departure	Year 50	32% (0)	11% (4)	31% (6)	5% (0)	21% (0)	**(10)**
Alt. F	Year 20	21% (0)	14% (1)	35% (10)	3% (2)	27% (2)	**(15)**
Alt F.	Year 50	34% (0)	10% (5)	31% (6)	5% (0)	20% (0)	**(11)**
Alt. E	Year 20	21% (0)	14% (1)	34% (9)	3% (2)	27% (2)	**(14)**
Alt. E	Year 50	35% (0)	11% (4)	29% (4)	5% (0)	20% (0)	**(8)**
Alt. D	Year 20	22% (0)	14% (1)	34% (9)	3% (2)	27% (2)	**(14)**
Alt. D	Year 50	35% (0)	11% (4)	29% (4)	5% (0)	20% (0)	**(8)**
Alt. C	Year 20	20% (0)	14% (1)	36% (11)	3% (2)	27% (2)	**(16)**
Alt. C	Year 50	33% (0)	10% (5)	32% (7)	5% (0)	20% (0)	**(12)**
Alt. B	Year 20	21% (0)	14% (1)	35% (10)	3% (2)	28% (3)	**(16)**
Alt. B	Year 50	34% (0)	10% (5)	34% (9)	5% (0)	20% (0)	**(14)**
Alt. A	Year 20	20% (0)	14% (1)	35% (10)	3% (2)	27% (2)	**(15)**
Alt. A	Year 50	33% (0)	10% (5)	32% (7)	5% (0)	20% (0)	**(12)**

DC = desired condition; SI = stand initiation; SE = stem exclusion; UR = understory reinitiation; OFSS = old forest single story; OFMS = old forest multi-story

The largest current deviation from desired conditions is in terms of a surplus of understory reinitiation and old forest multi-story stages. All of the alternatives make substantial improvements in terms of moving the stages toward the historical range of variability, but Alternatives D and E are estimated to obtain the best results within both the 20-year and 50-year horizons. All of the other alternatives would also substantially reduce the existing condition's 40-point total variation. Relatively modest levels of active management were scheduled within the cold upland forest, so the similar results across alternatives may be driven largely by natural disturbance effects.

Wallowa-Whitman National Forest – Structural Stages of the Dry Upland Forest

The dry upland forest makes up about half of the Wallowa-Whitman's forest landscape. With the existing condition showing a total variation from the historical range of variability of 89, it is also the most highly departed of all the forest potential vegetation groups from the desired conditions. The most significant deviations currently are in terms of a very large surplus of understory reinitiation stages and a lack of old forest single story stages. With their very ambitious objectives for thinning harvests, Alternatives D, E-Modified and E-Modified Departure would likely make the most progress toward the desired conditions within the 20-year timeframe. These three alternatives would reduce the total variation from desired conditions to about 75 to 76 within 20 years. Alternative E-Modified and E-Modified Departure version both indicate the best expected results over the 50-year time frame. Both of these alternatives would cut the potential vegetation group's current variation substantially over the 50-year time frame, to levels of about 63.

The total summed variation as an indicator may tend to miss some of the significance in terms of the changes expected within the dry upland forest. The alternatives that are more aggressive with active restoration would thin a large amount of what is now understory reinitiation stage, and thus it would be reclassified as stem exclusion stages. In the near term, when looking just at total variation as a metric, this merely results in a swap of a large variation in the understory reinitiation stages for a corresponding large variation in stem exclusion stages. What is missed in terms of the variation scoring is that the stem exclusion stages of the dry upland forest would likely represent a much more stable condition, less prone to atypical severe wildfire. The stem exclusion stages would also be poised to develop directly into future old forest single story stages, which are currently lacking. The understory reinitiation stages are very vulnerable to excessive fire behaviors, and in the absence of severe fire, they are likely to eventually develop into old forest multi-story stages, which are already overrepresented on the landscape. Alternatives E-Modified and E-Modified Departure, which reduce the understory reinitiation stages the most, may be superior for the Wallowa-Whitman National Forest in light of these considerations.

Alternatives A and C would be the least effective alternatives in achieving the desired conditions for structural stages in the Wallowa-Whitman's dry upland forest potential vegetation group. Under Alternatives A and C, the percent of the dry upland forest potential vegetation group in each of the structural stages would still be expected to vary from the desired condition ranges by a summed total of approximately 85 to 86 points after 20 years. These trends of lagging performance continue into the 50-year time frame with total variations from desired conditions expected to remain around 77 to 78.

Table 280. Forest structural stages, as a percent of the dry upland forest potential vegetation group (with amount of variation from the desired condition range in parentheses) by alternative within the Wallowa-Whitman National Forest

Alternative	Time Period	Dry/SI DC = 15% – 30%	Dry /SE DC = 10% - 20%	Dry /UR DC = < 5%	Dry /OFSS DC = 40% - 65%	Dry /OFMS DC = 1% - 15%	Summed Total Amount of Variation
Not applicable	Existing Condition	14% (1)	16% (0)	54% (49)	1% (39)	14% (0)	**(89)**
Alt. E-Modified	Year 20	15% (0)	43% (23)	25% (20)	7% (33)	10% (0)	**(76)**
Alt. E-Modified	Year 50	15% (0)	49% (29)	14% (9)	15% (25)	7% (0)	**(63)**
Alt. E-Modified Departure	Year 20	14% (1)	51% (31)	17% (12)	9% (31)	9% (0)	**(75)**
Alt. E-Modified Departure	Year 50	15% (0)	50% (30)	13% (8)	15% (25)	7% (0)	**(63)**
Alt. F	Year 20	14% (1)	36% (16)	33% (28)	4% (36)	13% (0)	**(81)**
Alt F.	Year 50	17% (0)	43% (23)	22% (17)	9% (31)	9% (0)	**(71)**
Alt. E	Year 20	16% (0)	39% (19)	33% (28)	4% (36)	13% (0)	**(81)**
Alt. E	Year 50	19% (0)	46% (26)	22% (17)	9% (31)	9% (0)	**(71)**
Alt. D	Year 20	16% (0)	36% (16)	31% (26)	6% (34)	1% (0)	**(76)**
Alt. D	Year 50	18% (0)	43% (23)	19% (14)	11% (29)	8% (0)	**(66)**
Alt. C	Year 20	12% (3)	34% (14)	37% (32)	4% (36)	14% (0)	**(85)**
Alt. C	Year 50	14% (1)	39% (19)	29% (24)	7% (33)	12% (0)	**(77)**
Alt. B	Year 20	13% (2)	35% (15)	34% (29)	4% (36)	13% (0)	**(82)**
Alt. B	Year 50	15% (0)	42% (22)	25% (20)	8% (32)	11% (0)	**(74)**
Alt. A	Year 20	11% (4)	37% (17)	34% (29)	4% (36)	13% (0)	**(86)**
Alt. A	Year 50	12% (3)	44% (24)	25% (20)	9% (31)	11% (0)	**(78)**

DC = desired condition; SI = stand initiation; SE = stem exclusion; UR = understory reinitiation; OFSS = old forest single story; OFMS = old forest multi-story

Wallowa-Whitman National Forest – Structural Stages of the Moist Upland Forest

The Wallowa-Whitman's moist upland forest component makes up about one quarter of the overall forested landscape. With the existing condition showing a total variation from the historical range of variability of 56 points, it is not as highly departed from the desired conditions as the dry upland forest potential vegetation group. The largest deviations are in terms of a significant surplus of understory reinitiation stages and deficits in stand initiation, stem exclusion, and old forest single story stages. Alternatives E-Modified and E-Modified Departure would likely make the most progress toward the desired conditions in the 20-year timeframe. These two alternatives would reduce the total variation from desired conditions to about 25 or 20 points respectively within 20 years. Looking out to the 50-year time frame shows Alternatives D and E-Modified as the best performing options, with the total variation from desired conditions reduced to about 12 points after five decades.

Table 281. Forest structural stages, as a percent of the moist upland forest potential vegetation group (with amount of variation from the desired condition range in parentheses) by alternative within the Wallowa-Whitman National Forest

Alternative	Time Period	Moist/SI DC = 20% – 30%	Moist /SE DC = 20% - 30%	Moist /UR DC = 15% - 25%	Moist /OFSS DC = 10% - 20%	Moist /OFMS DC = 15% - 20%	Summed Total Amount of Variation
Not applicable	Existing Condition	9% (11)	10% (10)	26% (1)	23% (3)	32% (12)	(37)
Alt. E-Modified	Year 20	10% (10)	14% (6)	28% (3)	13% (0)	35% (15)	(34)
Alt. E-Modified	Year 50	14% (6)	16% (4)	34% (9)	7% (3)	29% (9)	(31)
Alt. E-Modified Departure	Year 20	12% (8)	15% (5)	25% (0)	13% (0)	35% (15)	(28)
Alt. E-Modified Departure	Year 50	16% (4)	15% (5)	34% (9)	6% (4)	29% (9)	(31)
Alt. F	Year 20	9% (11)	14% (6)	26% (1)	15% (0)	36% (16)	(34)
Alt F.	Year 50	12% (8)	16% (4)	34% (9)	9% (1)	28% (8)	(30)
Alt. E	Year 20	11% (9)	15% (5)	28% (3)	14% (0)	32% (12)	(29)
Alt. E	Year 50	13% (7)	18% (2)	33% (8)	8% (2)	28% (8)	(27)
Alt. D	Year 20	11% (9)	14% (6)	25% (0)	15% (0)	36% (16)	(31)
Alt. D	Year 50	17% (3)	20% (0)	8% (7)	28% (8)	28% (8)	(26)
Alt. C	Year 20	8% (12)	14% (6)	27% (2)	16% (0)	37% (17)	(37)
Alt. C	Year 50	9% (11)	16% (4)	37% (12)	10% (0)	29% (9)	(36)
Alt. B	Year 20	8% (12)	13% (7)	27% (2)	14% (0)	37% (17)	(38)
Alt. B	Year 50	11% (9)	16% (4)	36% (11)	8% (2)	29% (9)	(35)
Alt. A	Year 20	7% (13)	14% (6)	27% (2)	15% (0)	37% (17)	(38)
Alt. A	Year 50	8% (12)	18% (2)	36% (11)	9% (1)	29% (9)	(35)

DC = desired condition; SI = stand initiation; SE = stem exclusion; UR = understory reinitiation; OFSS = old forest single story; OFMS = old forest multi-story

Alternatives B and C stand out as being the least effective alternatives in achieving the structural desired conditions for the Wallowa-Whitman's moist upland forest potential vegetation group. Under these two alternatives, modest progress is expected, as the structural stages would still vary from the desired condition ranges by a summed total of approximately 40 to 41 points after 20 years. These trends of relatively poor performance continue into the 50-year time frame, with the total variations from desired conditions expected to remain around 30 to 32.

Species Composition

The alternatives that result in the closest achievement of the desired conditions for species composition groups would result in vegetation that is more ecologically resilient within each particular upland forest potential vegetation group. By maintaining and/or restoring the balance of shade tolerant, intolerant and intermediate tolerant species that occurred and evolved on a site prior to interruption of the historical fire regimes, forests would be better adapted to drought stress and disturbance regimes.

Malheur National Forest Species Composition – Cold Upland Forest

The cold upland forest makes up a very small portion of the Malheur's forest landscape. Currently, the largest deviation from desired conditions for species composition is an underrepresentation of the shade tolerant species group.

Table 282. Forest species composition, as a percent of the cold upland forest potential vegetation group (with amount of variation from the desired condition range in parentheses) by alternative within the Malheur National Forest

Alternative	Time Period	Cold/Shade Intolerant DC = 40% – 60%	Cold/Intermediate Tolerance DC = 5% - 20%	Cold/Shade Tolerant DC = 25% - 50%	Summed Total Amount of Variation
Not applicable	Existing Condition	63% (3)	31% (11)	7% (18)	**(32)**
Alt. E-Modified	Year 20	60% (0)	31% (11)	9% (16)	**(27)**
Alt. E-Modified	Year 50	60% (0)	29% (9)	11% (14)	**(23)**
Alt. E-Modified Departure	Year 20	60% (0)	31% (11)	9% (16)	**(27)**
Alt. E-Modified Departure	Year 50	59% (0)	30% (10)	11% (14)	**(24)**
Alt. F	Year 20	62% (2)	28% (8)	9% (16)	**(26)**
Alt F.	Year 50	63% (3)	26% (6)	11% (14)	**(23)**
Alt. E	Year 20	63% (3)	28% (8)	9% (16)	**(27)**
Alt. E	Year 50	65% (5)	24% (4)	11% (14)	**(23)**
Alt. D	Year 20	63% (3)	28% (8)	9% (16)	**(27)**
Alt. D	Year 50	67% (7)	23% (3)	10% (15)	**(25)**
Alt. C	Year 20	61% (1)	30% (10)	9% (16)	**(27)**
Alt. C	Year 50	61% (1)	28% (8)	11% (14)	**(23)**
Alt. B	Year 20	62% (2)	30% (10)	9% (16)	**(28)**
Alt. B	Year 50	62% (2)	27% (7)	11% (14)	**(23)**
Alt. A	Year 20	61% (1)	30% (10)	9% (16)	**(27)**
Alt. A	Year 50	61% (1)	29% (9)	11% (14)	**(24)**

DC= desired condition

All of the alternatives make similar levels of minimal progress toward increasing the proportion of shade tolerant species in the cold upland forest potential vegetation group. The degree of variation for the cold upland potential vegetation group is expected to drop to between 26 to 28 points after 20 years. At year 50, the alternatives are all fairly consistently showing total variation of 23 to 25 points. Relatively modest levels of active management were scheduled within the cold upland forest, so the similar results across alternatives may be influenced largely by natural gradual succession effects along with disturbances.

Malheur National Forest Species Composition – Dry Upland Forest

The dry upland forest makes up the vast majority of the Malheur's forest landscape. Currently the dry upland forest potential vegetation group's species composition is very close to being within the range of desired conditions. Most of the alternatives would do well in terms of maintaining these low levels of departure from the historical range of variability over both the 20- and 50-year timeframes. Alternatives D and E-Modified Departure would be likely to be completely within the desired conditions after 50 years. Conversely, Alternative C would be the least effective in terms of maintaining desired conditions, with the total amount of variation expected to increase to 6 and 10 points at the 20-year and 50-year time horizons respectively.

Table 283. Forest species composition, as a percent of the dry upland forest potential vegetation group (with amount of variation from the desired condition range in parentheses) by alternative within the Malheur National Forest

Alternative	Time Period	Dry/Shade Intolerant DC = 75% – 90%	Dry/Intermediate Tolerance DC = 5% - 20%	Summed Total Amount of Variation
Not applicable	Existing Condition	76% (0)	24% (4)	(4)
Alt. E-Modified	Year 20	77% (0)	23% (3)	(3)
Alt. E-Modified	Year 50	79% (0)	21% (1)	(1)
Alt. E-Modified Departure	Year 20	79% (0)	21% (1)	(1)
Alt. E-Modified Departure	Year 50	80% (0)	20% (0)	(0)
Alt. F	Year 20	76% (0)	24% (4)	(4)
Alt F.	Year 50	76% (0)	24% (4)	(4)
Alt. E	Year 20	77% (0)	23% (3)	(3)
Alt. E	Year 50	78% (0)	22% (2)	(2)
Alt. D	Year 20	77% (0)	23% (3)	(3)
Alt. D	Year 50	80% (0)	20% (0)	(0)
Alt. C	Year 20	75% (0)	26% (6)	(6)
Alt. C	Year 50	73% (2)	28% (8)	(10)
Alt. B	Year 20	75% (0)	25% (5)	(5)
Alt. B	Year 50	75% (0)	25% (5)	(5)
Alt. A	Year 20	75% (0)	25% (5)	(5)
Alt. A	Year 50	74% (0)	26% (6)	(6)

DC= desired condition

Malheur National Forest Species Composition – Moist Upland Forest

Like the cold upland forest, the Malheur's moist upland forest is a relatively minor component of the overall forested landscape. With the existing condition showing a total variation of 66 points from the historical range of variability, it is currently significantly departed from the desired conditions. The largest deviation is a substantial surplus of shade tolerant species. All of the alternatives would make only modest progress in terms of improving the species composition mix in the 20-year timeframe. Alternatives D and E would make the most progress, by reducing the total variation from desired conditions to about to 61 within 20 years. Looking out to the 50-year time frame shows Alternatives D and E-Modified Departure as the best performing options, with the total variation from desired conditions being reduced to about 48 to 50 points after five decades. In comparison, Alternatives E and E-Modified would also produce similar results, with total variation of 51 to 52 points expected within the same time frame.

Alternatives A, B and C stand out as being the least effective alternatives in achieving the desired species composition conditions for the Malheur's moist upland forest. Under these alternatives, little improvement is indicated, as the species composition would still vary from the desired condition ranges by a summed total of approximately 63 to 64 points after 20 years. These trends of relatively weak performance continue through the 50-year time frame, with total variations from desired conditions expected to remain around 58.

None of the alternatives would address the restoration of species compositions very well within the time frame of the next expected planning cycle. Maintaining an excess of the moist upland

forest potential vegetation group in shade tolerant species would likely result in decreased ecological resiliency. These more shade tolerant tree species are less able to withstand fire due to thinner bark and their branching characteristics readily support torching and active crown fire. Shade tolerant tree species of the moist upland forest also tend to be less drought tolerant, and more susceptible to attack by certain insects and decay fungi.

Table 284. Forest species composition, as a percent of the moist upland forest potential vegetation group (with amount of variation from the desired condition range in parentheses) by alternative within the Malheur National Forest

Alternative	Time Period	Moist/Shade Intolerant DC = 30% – 60%	Moist /Intermediate Tolerance DC = 20% - 40%	Moist /Shade Tolerant DC = 10% - 30%	Summed Total Amount of Variation
Not applicable	Existing Condition	21% (9)	6% (14)	73% (43)	**(66)**
Alt. E-Modified	Year 20	21% (9)	8% (12)	71% (41)	**(62)**
Alt. E-Modified	Year 50	25% (5)	9% (11)	66% (36)	**(52)**
Alt. E-Modified Departure	Year 20	21% (9)	8% (12)	71% (41)	**(62)**
Alt. E-Modified Departure	Year 50	26% (4)	9% (11)	65% (35)	**(50)**
Alt. F	Year 20	21% (9)	8% (12)	71% (4)	**(62)**
Alt F.	Year 50	22% (8)	10% (10)	68% (38)	**(56)**
Alt. E	Year 20	21% (9)	9% (11)	71% (41)	**(61)**
Alt. E	Year 50	24% (6)	11% (9)	66% (36)	**(51)**
Alt. D	Year 20	21% (9)	8% (12)	70% (40)	**(61)**
Alt. D	Year 50	26% (4)	10% (10)	64% (34)	**(48)**
Alt. C	Year 20	20% (10)	8% (12)	72% (42)	**(64)**
Alt. C	Year 50	21% (9)	10% (10)	69% (39)	**(58)**
Alt. B	Year 20	20% (10)	8% (12)	72% (42)	**(63)**
Alt. B	Year 50	21% (9)	10% (10)	69% (39)	**(58)**
Alt. A	Year 20	20% (10)	8% (12)	71% (41)	**(63)**
Alt. A	Year 50	20% (10)	11% (9)	69% (39)	**(58)**

DC= desired condition

Umatilla National Forest Species Composition – Cold Upland Forest

The cold upland forest represents only about 10 percent of the Umatilla's forest landscape. Currently, the largest deviation from desired conditions for species composition is a modest excess of stands within the shade intolerant group species group. Overall, the Umatilla's cold upland forest potential vegetation group is only slightly departed from the desired species distribution. All of the alternatives make similar levels of minimal progress toward decreasing the proportion of shade intolerant species in the cold upland forest. The degree of variation for the cold upland potential vegetation group is expected to drop to between 10 to 12 points after 20 years. At year 50, the alternatives are all fairly consistently showing total variation between 11 to 14 points. Relatively modest levels of active management were scheduled within the cold upland forest, so the similar results across alternatives may be influenced largely by natural gradual succession effects along with disturbances.

Table 285. Forest species composition, as a percent of the cold upland forest potential vegetation group (with amount of variation from the desired condition range in parentheses) by alternative within the Umatilla National Forest

Alternative	Time Period	Cold/Shade Intolerant DC = 40% – 60%	Cold/Intermediate Tolerance DC = 5% - 20%	Cold/Shade Tolerant DC = 25% - 50%	Summed Total Amount of Variation
Not applicable	Existing Condition	70% (10)	10% (0)	20% (5)	**(15)**
Alt. E-Modified	Year 20	66% (6)	13% (0)	21% (4)	**(10)**
Alt. E-Modified	Year 50	66% (6)	15% (0)	19% (6)	**(12)**
Alt. E-Modified Departure	Year 20	67% (7)	13% (0)	20% (5)	**(12)**
Alt. E-Modified Departure	Year 50	65% (5)	16% (0)	19% (6)	**(11)**
Alt. F	Year 20	67% (7)	13% (0)	20% (5)	**(12)**
Alt F.	Year 50	67% (7)	14% (0)	19% (6)	**(13)**
Alt. E	Year 20	67% (7)	13% (0)	20% (5)	**(12)**
Alt. E	Year 50	67% (7)	14% (0)	19% (6)	**(13)**
Alt. D	Year 20	67% (7)	12% (0)	20% (5)	**(12)**
Alt. D	Year 50	68% (8)	13% (0)	19% (6)	**(14)**
Alt. C	Year 20	67% (7)	13% (0)	20% (5)	**(12)**
Alt. C	Year 50	66% (6)	15% (0)	19% (6)	**(12)**
Alt. B	Year 20	66% (6)	13% (0)	21% (4)	**(10)**
Alt. B	Year 50	66% (6)	15% (0)	19% (6)	**(12)**
Alt. A	Year 20	66% (6)	13% (0)	21% (4)	**(10)**
Alt. A	Year 50	66% (6)	15% (0)	19% (6)	**(12)**

DC= desired condition

Umatilla National Forest Species Composition – Dry Upland Forest

The dry upland forest makes up over half of the Umatilla’s forest landscape. With the existing condition showing a total variation from the historical range of variability of 65 points, it is currently significantly departed from the desired conditions. The deviation is a substantial surplus of intermediate and shade tolerant species, with a corresponding lack of shade intolerant species. Alternative E-Modified Departure would likely make the most progress toward the desired conditions within the 20-year timeframe. This alternative would reduce the total variation from desired conditions to about 37 points within 20 years. Alternatives D and E-Modified would also make substantial progress toward rebalancing species composition with total variations of 43 and 49, respectively, expected after 20 years. Looking out to the 50-year time frame shows Alternatives D and E-Modified Departure as the best performing options with the total variation from desired conditions reduced to about 19 to 25 points respectively after five decades.

Alternative C would clearly be the least effective alternative in achieving the desired species composition conditions for the Umatilla’s dry upland forest. Under these alternatives, conditions would only improve slightly within the 20-year time frame to a total variation of 62. Little improvement is indicated in the mid-term either, as the species composition would still vary from the desired condition ranges by a summed total of approximately 59 points after 50 years.

The overall results support the idea that alternatives with robust thinning, regeneration and prescribed fire programs could be relatively successful in reversing the negative trends of the dry forest's species composition. However, alternatives that would maintain a large excess of shade tolerant species within the dry upland forest would likely result in decreased ecological resiliency. These more shade tolerant tree species are less able to withstand fire due to thinner bark, and their branching characteristics readily support torching and uncharacteristic severe active crown fire. Shade-tolerant tree species of the dry upland forest also tend to be less drought tolerant, and more susceptible to attack by certain insects and decay fungi.

Table 286. Forest species composition, as a percent of the dry upland forest potential vegetation group (with amount of variation from the desired condition range in parentheses) by alternative within the Umatilla National Forest

Alternative	Time Period	Dry/Shade Intolerant DC = 75% – 90%	Dry/Intermediate Tolerance DC = 5% - 20%	Summed Total Amount of Variation
Not applicable	Existing Condition	45% (30)	55% (35)	**(65)**
Alt. E-Modified	Year 20	53% (22)	47% (27)	**(49)**
Alt. E-Modified	Year 50	62% (13)	38% (18)	**(31)**
Alt. E-Modified Departure	Year 20	59% (16)	41% (21)	**(37)**
Alt. E-Modified Departure	Year 50	65% (10)	35% (15)	**(25)**
Alt. F	Year 20	50% (25)	50% (30)	**(55)**
Alt F.	Year 50	58% (17)	42% (22)	**(39)**
Alt. E	Year 20	51% (24)	49% (29)	**(53)**
Alt. E	Year 50	59% (16)	41% (21)	**(37)**
Alt. D	Year 20	56% (19)	44% (24)	**(43)**
Alt. D	Year 50	68% (7)	32% (12)	**(19)**
Alt. C	Year 20	47% (28)	54% (34)	**(62)**
Alt. C	Year 50	48% (27)	52% (32)	**(59)**
Alt. B	Year 20	50% (25)	50% (30)	**(55)**
Alt. B	Year 50	56% (19)	44% (24)	**(43)**
Alt. A	Year 20	50% (25)	50% (30)	**(55)**
Alt. A	Year 50	55% (20)	45% (25)	**(45)**

DC= desired condition

Umatilla National Forest Species Composition – Moist Upland Forest

The Umatilla's moist upland forest component is significant, making up almost 40% of the overall forested landscape. With the existing condition showing a total variation from the historical range of variability of 50 points, it is currently significantly departed from the desired conditions. The largest deviation is a substantial surplus of shade tolerant species. Most of the alternatives would fail to make progress in terms of improving the species composition mix in the 20-year timeframe. However, Alternatives D, E and E-Modified Departure would reduce the total variation slightly from desired conditions to about 48 to 49 within 20 years. Looking out to the 50-year time frame shows Alternatives D as the best performing option with the total variation from desired conditions being reduced to about 40 points after five decades.

Alternatives A and B are the least effective alternatives in achieving the desired species composition conditions for the Umatilla's moist upland forest. Under these alternatives, conditions would be likely to degrade slightly within the 20-year time frame. Little improvement is indicated in the mid-term either, as the species composition would still vary from the desired condition ranges by a summed total of approximately 47 to 49 points after 50 years.

Table 287. Forest species composition, as a percent of the moist upland forest potential vegetation group (with amount of variation from the desired condition range in parentheses) by alternative within the Umatilla National Forest

Alternative	Time Period	Moist/Shade Intolerant DC = 30% – 60%	Moist /Intermediate Tolerance DC = 20% - 40%	Moist /Shade Tolerant DC = 10% - 30%	Summed Total Amount of Variation
Not applicable	Existing Condition	15% (15)	21% (0)	65% (35)	**(50)**
Alt. E-Modified	Year 20	15% (15)	21% (0)	65% (35)	**(50)**
Alt. E-Modified	Year 50	17% (13)	20% (0)	63% (33)	**(46)**
Alt. E-Modified Departure	Year 20	16% (14)	21% (0)	64% (34)	**(48)**
Alt. E-Modified Departure	Year 50	19% (11)	19% (1)	62% (32)	**(44)**
Alt. F	Year 20	15% (15)	21% (0)	65% (35)	**(50)**
Alt F.	Year 50	17% (13)	20% (0)	63% (33)	**(46)**
Alt. E	Year 20	15% (15)	21% (0)	64% (34)	**(49)**
Alt. E	Year 50	18% (12)	20% (0)	62% (32)	**(44)**
Alt. D	Year 20	16% (14)	20% (0)	64% (34)	**(48)**
Alt. D	Year 50	20% (10)	20% (0)	60% (30)	**(40)**
Alt. C	Year 20	15% (15)	21% (0)	65% (35)	**(50)**
Alt. C	Year 50	16% (14)	21% (0)	64% (34)	**(45)**
Alt. B	Year 20	14% (16)	21% (0)	65% (35)	**(51)**
Alt. B	Year 50	16% (14)	20% (0)	63% (33)	**(47)**
Alt. A	Year 20	14% (16)	21% (0)	65% (35)	**(51)**
Alt. A	Year 50	15% (15)	21% (0)	64% (34)	**(49)**

DC= desired condition

None of the alternatives would address the restoration of species compositions very well within the time frame of the next expected planning cycle. Maintaining an excess of the moist upland forest potential vegetation group in shade tolerant species would likely result in decreased ecological resiliency. These more shade tolerant tree species are less able to withstand fire due to thinner bark and their branching characteristics readily support torching and active crown fire. Shade tolerant tree species of the moist upland forest also tend to be less drought tolerant, and more susceptible to attack by certain insects and decay fungi.

Wallowa-Whitman National Forest Species Composition – Cold Upland Forest

Much of the cold upland forest potential vegetation group is located within existing or proposed wilderness, roadless or backcountry areas. Currently, the distribution of species composition is quite close to being within the range of desired conditions. All of the alternatives either maintain

or make minimal progress toward decreasing the total variation in the cold upland forest potential vegetation group over the next 50 years. Relatively modest levels of active management were scheduled within the cold upland forest, so the similar results across alternatives may be influenced largely by natural gradual succession effects along with disturbances.

Table 288. Forest species composition, as a percent of the cold upland forest potential vegetation group (with amount of variation from the desired condition range in parentheses) by alternative within the Wallowa-Whitman National Forest

Alternative	Time Period	Cold/Shade Intolerant DC = 40% – 60%	Cold/Intermediate Tolerance DC = 5% - 20%	Cold/Shade Tolerant DC = 25% - 50%	Summed Total Amount of Variation
Not applicable	Existing Condition	38% (2)	24% (4)	38% (0)	**(6)**
Alt. E-Modified	Year 20	39% (1)	24% (4)	37% (0)	**(5)**
Alt. E-Modified	Year 50	44% (0)	24% (4)	32% (0)	**(4)**
Alt. E-Modified Departure	Year 20	39% (1)	24% (4)	37% (0)	**(5)**
Alt. E-Modified Departure	Year 50	44% (0)	24% (4)	32% (0)	**(4)**
Alt. F	Year 20	39% (1)	24% (4)	37% (0)	**(5)**
Alt F.	Year 50	45% (0)	22% (2)	32% (0)	**(2)**
Alt. E	Year 20	40% (0)	24% (4)	37% (0)	**(4)**
Alt. E	Year 50	46% (0)	22% (2)	32% (0)	**(2)**
Alt. D	Year 20	40% (0)	23% (3)	36% (0)	**(3)**
Alt. D	Year 50	47% (0)	21% (1)	32% (0)	**(1)**
Alt. C	Year 20	39% (1)	24% (4)	37% (0)	**(5)**
Alt. C	Year 50	45% (0)	23% (3)	32% (0)	**(3)**
Alt. B	Year 20	39% (1)	24% (4)	37% (0)	**(5)**
Alt. B	Year 50	45% (0)	23% (3)	32% (0)	**(3)**
Alt. A	Year 20	39% (1)	24% (4)	37% (0)	**(5)**
Alt. A	Year 50	45% (0)	23% (3)	32% (0)	**(3)**

DC= desired condition

Wallowa-Whitman National Forest Species Composition – Dry Upland Forest

The dry upland forest makes up about half of the Wallowa-Whitman's forest landscape. With the existing condition showing a total variation from the historical range of variability of 65, it is significantly departed from the desired conditions for species composition. The deviation is a substantial surplus of intermediate and shade tolerant species, with a corresponding lack of shade intolerant species. Alternatives D and E-Modified Departure would likely make the most progress toward the desired conditions within the 20-year timeframe. These alternatives would reduce the total variation from desired conditions to about 40 to 41 points within 20 years. Alternative E-Modified would also make substantial progress toward rebalancing the species composition with a total variation of 47 expected after 20 years. Looking out to the 50-year time frame shows Alternative D as the best performing option with the total variation from desired conditions reduced to about 21 points after five decades.

Table 289. Forest species composition, as a percent of the dry upland forest potential vegetation group (with amount of variation from the desired condition range in parentheses) by alternative within the Wallowa-Whitman National Forest

Alternative	Time Period	Dry/Shade Intolerant DC = 75% – 90%	Dry/Intermediate Tolerance DC = 5% - 20%	Summed Total Amount of Variation
Not applicable	Existing Condition	45% (30)	55% (35)	**(65)**
Alt. E-Modified	Year 20	54% (21)	46% (26)	**(47)**
Alt. E-Modified	Year 50	62% (13)	38% (18)	**(31)**
Alt. E-Modified Departure	Year 20	57% (18)	43% (23)	**(41)**
Alt. E-Modified Departure	Year 50	63% (12)	37% (17)	**(29)**
Alt. F	Year 20	50% (25)	50% (30)	**(55)**
Alt F.	Year 50	56% (19)	44% (24)	**(43)**
Alt. E	Year 20	52% (23)	48% (28)	**(51)**
Alt. E	Year 50	60% (15)	40% (20)	**(35)**
Alt. D	Year 20	55% (20)	45% (20)	**(40)**
Alt. D	Year 50	67% (8)	33% (13)	**(21)**
Alt. C	Year 20	47% (28)	53% (33)	**(61)**
Alt. C	Year 50	48% (27)	52% (32)	**(59)**
Alt. B	Year 20	49% (26)	50% (30)	**(56)**
Alt. B	Year 50	54% (21)	45% (25)	**(46)**
Alt. A	Year 20	49% (26)	51% (31)	**(57)**
Alt. A	Year 50	53% (22)	47% (27)	**(49)**

DC= desired condition

Alternative C would be the least effective alternative in achieving the desired species composition conditions for the Wallowa-Whitman’s dry upland forest potential vegetation group. Under this alternative, conditions would only improve slightly within the 20-year time frame to a total variation of 61. Little improvement is indicated in the mid-term either, as the species composition would still vary from the desired condition ranges by a summed total of approximately 59 points after 50 years.

The overall results support the idea that alternatives with robust thinning, regeneration and prescribed fire programs should be relatively successful in reversing the negative trends in the dry forest’s species composition. However, alternatives that would maintain a large excess of shade tolerant species within the dry upland forest would likely result in decreased ecological resiliency. These more shade tolerant tree species are less able to withstand fire due to thinner bark, and their branching characteristics readily support torching and uncharacteristic severe active crown fire. Shade tolerant tree species of the dry upland forest also tend to be less drought tolerant, and more susceptible to attack by certain insects and decay fungi.

Wallowa-Whitman National Forest Species Composition – Moist Upland Forest

The Wallowa-Whitman’s moist upland forest component makes up about one quarter of the overall forest landscape. With the existing condition showing a total variation from the historical range of variability of 19 points, it is currently moderately departed from the desired conditions. The largest deviation is a surplus of shade tolerant species. Most of the alternatives would make

little if any progress in terms of improving the species composition mix in the 20-year timeframe. However, Alternatives D and E-Modified Departure would reduce the total variation slightly from desired conditions to about 17 within 20 years. Looking out to the 50-year time frame shows Alternatives D, E, E-Modified and E-Modified Departure as the best performing options, with the total variation from desired conditions being reduced to about 12 to 13 points after five decades.

Table 290. Forest species composition, as a percent of the moist upland forest potential vegetation group (with amount of variation from the desired condition range in parentheses) by alternative within the Wallowa-Whitman National Forest

Alternative	Time Period	Moist/Shade Intolerant DC = 30% – 60%	Moist /Intermediate Tolerance DC = 20% - 40%	Moist /Shade Tolerant DC = 10% - 30%	Summed Total Amount of Variation
Not applicable	Existing Condition	27% (3)	27% (0)	46% (16)	**(19)**
Alt. E-Modified	Year 20	27% (3)	27% (0)	46% (16)	**(19)**
Alt. E-Modified	Year 50	32% (0)	25% (0)	43% (13)	**(13)**
Alt. E-Modified Departure	Year 20	28% (2)	27% (0)	45% (15)	**(17)**
Alt. E-Modified Departure	Year 50	32% (0)	25% (0)	43% (13)	**(13)**
Alt. F	Year 20	27% (3)	27% (0)	46% (16)	**(19)**
Alt F.	Year 50	29% (1)	25% (0)	45% (15)	**(16)**
Alt. E	Year 20	28% (2)	26% (0)	46% (16)	**(18)**
Alt. E	Year 50	32% (0)	25% (0)	43% (13)	**(13)**
Alt. D	Year 20	28% (2)	27% (0)	45% (15)	**(17)**
Alt. D	Year 50	33% (0)	25% (0)	42% (12)	**(12)**
Alt. C	Year 20	26% (4)	27% (0)	47% (17)	**(21)**
Alt. C	Year 50	26% (4)	27% (0)	47% (17)	**(21)**
Alt. B	Year 20	26% (4)	27% (0)	46% (16)	**(20)**
Alt. B	Year 50	27% (3)	26% (0)	46% (16)	**(19)**
Alt. A	Year 20	26% (4)	27% (0)	47% (17)	**(21)**
Alt. A	Year 50	26% (4)	27% (0)	47% (17)	**(21)**

DC= desired condition

Alternatives A, B and C are the least effective alternatives in achieving the desired species composition conditions for the Wallowa-Whitman's moist upland forest potential vegetation group. Under these alternatives, conditions would be likely to degrade slightly within the 20-year time frame. Little improvement is indicated in the mid-term either, as the species composition would still vary from the desired condition ranges by a summed total of approximately 19 to 21 points after 50 years.

None of the alternatives would address the restoration of species compositions very well within the time frame of the next expected planning cycle, though the current level of deviation from desire conditions is fairly small. However, maintaining an excess of the moist upland forest potential vegetation group in shade tolerant species could result in decreased ecological resiliency. These more shade tolerant tree species are less able to withstand fire due to thinner bark and their branching characteristics readily support torching and active crown fire. Shade

tolerant tree species of the moist upland forest also tend to be less drought tolerant, and more susceptible to attack by certain insects and decay fungi.

Aspen

Mortality of mature aspen coupled with poor regeneration as a result of fire exclusion and continued browsing pressure by deer, elk and cattle are the major processes negatively affecting aspen throughout the Blue Mountains region. If these circumstances don't change, they are expected to result in continued vegetation changes, with eventual type conversion from aspen to conifers or grassland within the next 80 to 200 years (Strand et al. 2009). Loss of aspen clones at a landscape scale would result in decreased biological diversity, with aspen decline cascading into losses of vertebrate species, understory vascular plants, and likely species from a myriad of other organismal groups (Strand et al. 2009).

All the alternatives have the desire to retain aspen on the landscape by ensuring that late mature, declining stands currently in danger of dying out entirely are successfully regenerated. Similarly, all alternatives share the desire to see a balanced diversity of age and structure classes existing among clones and stands. It is recognized that the attainment of these goals for aspen, will be influenced to great deal across all alternatives by processes beyond forest management activities. Examples of aspen loss not related to forest management include browsing of aspen seedlings and saplings, insects and diseases, and drought related sudden aspen decline. Sudden aspen decline is distinct from general age-induced dieback, as it is a sudden, landscape-scale event that can lead to loss of most of an aspen stand (Worrall et al. 2008). Results from Hanna and Kulakowski's (2012) study of aspen mortality throughout the western U.S. suggests that aspen die-off is strongly associated with recent climatic conditions.

Management approaches to restoring aspen that would be used by all of the alternatives include the construction of deer, elk and cattle exclosures, mechanical or prescribed fire regeneration treatments, wildland fire use, establishment of new aspen stands using containerized planting stock, browse protection, removal of competing conifers, mechanical root stimulation (ripping) and the use of genetic variation data to guide management decisions.

Because clonal aspen stands tend to occur as smaller, scattered patches across the landscape, implementing stand-alone prescribed burning or mechanical stimulation projects solely for increasing regeneration within aspen clones may be difficult due to logistical considerations and costs. Within all three National Forests, the alternatives with generally higher harvesting and prescribed burning objectives like, D, E, E-Modified and E-Modified Departure may allow for more opportunities to use these tools efficiently to simultaneously improve the health, vigor and sustainability of aspen populations.

Aspen are very intolerant of shaded growing conditions and conifers that have grown into these stands during the period of modern fire suppression bring undesired competition and shaded environments to the aspen stands. In some cases these relatively young conifers trees have grown in excess of 21 inches diameter. Alternatives A and C, with strict restrictions on the harvesting of trees 21 inches diameter and greater, could result in restricting the ability to remove encroaching conifers from within these aspen stands. Alternative D would have no such restrictions and Alternatives B, E-Modified and E-Modified Departure would incorporate specific management direction to accommodate these situations. While Alternatives E and F would place restrictions on the harvesting of older trees, these restrictions would not be anticipated to restrict aspen restoration activities substantially because conifers that are generally targeted for removal would

be those which have encroached relatively recently due to fire suppression (less than 150 years old).

Whitebark Pine

All of the alternatives have the same desired conditions for whitebark pine to maintain or increase its presence in appropriate high elevation areas. The Pacific Northwest Region has currently developed a whitebark pine restoration strategy that contains a comprehensive restoration plan (Aubry 2008). This plan includes several possible management strategies, such as collecting whitebark pine seed, planting seed or seedlings, thinning competing trees, pruning tree limbs infected with blister rust, increasing genetic resistance to blister rust, evaluating areas where health, stand conditions, and restoration needs are unknown, and working collaboratively to increase understanding of impacts affecting whitebark pine communities.

Under all of the alternatives, these management options would be available, and if fully implemented, much degraded whitebark pine habitat and connectivity would be restored. Genetic diversity would be conserved across the landscape, resistance to white pine blister rust would be increased and populations would exhibit an increase in age class diversity. The risk of mortality from mountain pine beetle and stand-replacing fire would be reduced.

Large, high-severity fires have the potential to severely reduce or even eliminate cone-bearing whitebark pine across an extensive landscape (Aubry et al. 2008). Conifers that have grown into whitebark stands during the period of modern fire suppression often facilitate these types of events by changing the fuel characteristics in the area. In some cases, these relatively young encroaching conifer trees have grown in excess of 21 inches diameter. Alternatives A and C, with strict restrictions on the harvesting of trees 21 inches diameter and greater, could result in restricting the ability to remove these encroaching conifers from within whitebark stands. Alternative D would have no such restrictions, and Alternatives B, E-Modified and E-Modified Departure would incorporate specific management direction to accommodate these situations. While Alternatives E and F would place restrictions on the harvesting of older trees, these restrictions would not be anticipated to substantially restrict whitebark restoration activities because conifers that are generally targeted for removal would be those which have encroached relatively recently due to fire suppression (less than 150 years old).

Under Alternatives C, E, F and E-Modified, relative to the other alternatives, additional areas would be allocated to MA 1B (recommended wilderness). Until final decisions are made by Congress, these areas would be managed to protect wilderness characteristics. The extent of recommended wilderness areas included in these alternatives could result in negative impacts on the ability to restore whitebark pine by limiting the tools available to conduct active whitebark pine management, such as tree planting of blister-rust resistant stock or thinning of competing vegetation. Prescribed burning to maintain vegetative types is not permitted in these areas, and Forest Service fire management objectives within wilderness or recommended wilderness areas call for lightning caused wildfires to fulfill as nearly as possible, their natural role. These objectives could increase the risk of undesired mortality of whitebark pine.

Forest Stand Density

Malheur National Forest Stand Density – Cold Upland Forest

The cold upland forest makes up a very small portion of the Malheur's forest landscape. With the existing condition showing a total variation from the historical range of variability of 111, it is highly departed from the range of desired stand density conditions. The deviation from desired

conditions stems from a large excess of low-density stand conditions and a corresponding lack of high-density stands.

Table 291. Forest stand density class, as a percent of the cold upland forest potential vegetation group (with amount of variation from the desired condition range in parentheses) by alternative within the Malheur National Forest

Alternative	Time Period	Cold/Open (Low density) DC = 20% – 30%	Cold/Closed (High density) DC = 65% - 80%	Summed Total Amount of Variation
Not applicable	Existing Condition	88% (58)	12% (53)	**(111)**
Alt. E-Modified	Year 20	50% (20)	50% (15)	**(35)**
Alt. E-Modified	Year 50	32% (2)	68% (0)	**(2)**
Alt. E-Modified Departure	Year 20	51% (21)	49% (16)	**(37)**
Alt. E-Modified Departure	Year 50	32% (2)	68% (0)	**(0)**
Alt. F	Year 20	49% (19)	51% (14)	**(33)**
Alt F.	Year 50	50% (20)	50% (15)	**(35)**
Alt. E	Year 20	51% (21)	49% (16)	**(37)**
Alt. E	Year 50	53% (23)	47% (18)	**(34)**
Alt. D	Year 20	53% (23)	47% (18)	**(41)**
Alt. D	Year 50	54% (24)	46% (19)	**(43)**
Alt. C	Year 20	46% (16)	54% (11)	**(27)**
Alt. C	Year 50	48% (18)	52% (13)	**(31)**
Alt. B	Year 20	53% (23)	47% (18)	**(41)**
Alt. B	Year 50	49% (19)	51% (14)	**(33)**
Alt. A	Year 20	46% (16)	54% (11)	**(27)**
Alt. A	Year 50	48% (18)	52% (13)	**(31)**

DC= desired condition

Under all of the alternatives, similar levels of significant progress toward increasing the proportion of high-density stands in the cold upland forest potential vegetation group are expected within 20 years. The best 20-year results are expected under Alternatives A and C, which feature relatively low levels of active management. The degree of variation for the cold upland potential vegetation group is expected to drop to around 27 points after 20 years for these two alternatives. Looking at the mid-term timeframe shows that across Alternatives A through F, progress either slows dramatically, or stops completely. However, Alternatives E-Modified and E-Modified Departure show very different expected results in the mid-term, with desired conditions essentially being achieved by year 50. Since these two alternatives assumed very little active management taking place within the cold upland forest, the results indicate that lack of major disturbance and/or active management may be mostly what is needed to address the desired conditions for more high-density stand conditions within the cold upland forest.

Malheur National Forest Stand Density – Dry Upland Forest

The dry upland forest makes up the vast majority of the Malheur's forest landscape. With the existing condition showing a total variation from the historical range of variability of 40, it is currently moderately departed from the desired conditions. The largest deviation exists in terms of an excess of high-density stand conditions and a corresponding lack of low-density conditions.

With its ambitious objectives for thinning harvests, and focus on the dry upland forest, E-Modified Departure would be likely to make the most progress toward the desired conditions in the 20-year timeframe. This alternative would reduce the total variation from desired conditions to about 12 points within 20 years. Alternatives D and E-Modified would be the next best options in the near term, as they would drop the dry upland forest's variation to 32 to 34 points. Despite the indicated differences in near term performance, all three of these alternatives would seem likely to result in similar levels of progress over the mid-term 50-year horizon. They would bring the potential vegetation group's current variation to between 16 to 20 points over the 50-year time frame.

Table 292. Forest stand density class, as a percent of the dry upland forest potential vegetation group (with amount of variation from the desired condition range in parentheses) by alternative within the Malheur National Forest

Alternative	Time Period	Dry/Open (Low density) DC = 80% – 90%	Dry/Closed (High density) DC = 5% - 20%	Summed Total Amount of Variation
Not applicable	Existing Condition	60% (20)	40% (20)	**(40)**
Alt. E-Modified	Year 20	63% (17)	37% (17)	**(34)**
Alt. E-Modified	Year 50	70% (10)	30% (10)	**(20)**
Alt. E-Modified Departure	Year 20	74% (6)	26% (6)	**(12)**
Alt. E-Modified Departure	Year 50	72% (8)	28% (8)	**(16)**
Alt. F	Year 20	56% (24)	44% (24)	**(48)**
Alt F.	Year 50	59% (21)	41% (21)	**(42)**
Alt. E	Year 20	61% (19)	39% (19)	**(38)**
Alt. E	Year 50	69% (11)	31% (11)	**(22)**
Alt. D	Year 20	64% (16)	36% (16)	**(32)**
Alt. D	Year 50	72% (8)	28% (8)	**(16)**
Alt. C	Year 20	52% (28)	49% (29)	**(57)**
Alt. C	Year 50	51% (29)	50% (30)	**(59)**
Alt. B	Year 20	56% (24)	44% (24)	**(48)**
Alt. B	Year 50	56% (24)	44% (24)	**(48)**
Alt. A	Year 20	55% (25)	45% (25)	**(50)**
Alt. A	Year 50	57% (23)	43% (23)	**(46)**

DC= desired condition

Alternatives A, B, C and F are all ineffective in terms of improving the stand density conditions of the dry upland forest. All of these alternatives would allow conditions to continue to worsen over time and result in increased levels of total variation from desired conditions. Alternative C would be the most counterproductive option with total variation expected to increase to 57 and then 59 points over the 20-year and 50-year time horizons respectively. Allowing stand densities of the dry upland forest to move away from the desired conditions would likely result in continued risk of uncharacteristic severe wildfire as well as elevated susceptibility to insects or disease as high levels of inter-tree competition are allowed to continue.

Some of the alternatives, would put less emphasis on using mechanical treatments to reduce stand densities, and would instead, rely mainly on the use of fire (planned and unplanned ignitions) to

reduce stand densities. However, opportunities to utilize fire within stands already existing in a high-density condition would likely be limited by the risk of unintentionally causing undesirable high-severity effects. Pretreatment of these dense stands by mechanical means before utilizing prescribed fire would probably prove more effective than using fire alone (Kalies and Kent 2016).

Malheur National Forest Stand Density – Moist Upland Forest

Like the cold upland forest, the Malheur's moist upland forest is a relatively minor component of the overall forest landscape. With the existing condition showing a total variation from the historical range of variability of 36, it is currently moderately departed from the range of desired conditions for stand density.

Table 293. Forest stand density class, as a percent of the dry upland forest potential vegetation group (with amount of variation from the desired condition range in parentheses) by alternative within the Malheur National Forest

Alternative	Time Period	Moist/Open (Low density) DC = 30% – 40%	Moist/Closed (High density) DC = 60% - 80%	Summed Total Amount of Variation
Not applicable	Existing Condition	58% (18)	42% (18)	**(36)**
Alt. E-Modified	Year 20	44% (4)	56% (4)	**(8)**
Alt. E-Modified	Year 50	29% (1)	71% (0)	**(1)**
Alt. E-Modified Departure	Year 20	33% (0)	67% (0)	**(0)**
Alt. E-Modified Departure	Year 50	27% (3)	73% (0)	**(3)**
Alt. F	Year 20	34% (0)	66% (0)	**(0)**
Alt F.	Year 50	37% (0)	63% (0)	**(0)**
Alt. E	Year 20	36% (0)	64% (0)	**(0)**
Alt. E	Year 50	40% (0)	60% (0)	**(0)**
Alt. D	Year 20	41% (1)	58% (2)	**(3)**
Alt. D	Year 50	45% (5)	55% (5)	**(10)**
Alt. C	Year 20	31% (0)	69% (0)	**(0)**
Alt. C	Year 50	33% (0)	68% (0)	**(0)**
Alt. B	Year 20	38% (0)	62% (0)	**(0)**
Alt. B	Year 50	33% (0)	67% (0)	**(0)**
Alt. A	Year 20	33% (0)	67% (0)	**(0)**
Alt. A	Year 50	35% (0)	65% (0)	**(0)**

DC= desired condition

All of the alternatives show the ability to either achieve or come close to achieving conditions close to the historical range over the next 20 years. However, looking at the mid-term timeframe shows the progress trend reversing itself to some extent for Alternative D. While all of the other alternatives would achieve and maintain the desired conditions over the 50-year time horizon, the management regime of Alternative D appears to be counterproductive over the 50-year time horizon. These results suggest that management regimes designed to effectively maintain desired conditions will necessarily be different from active restoration programs. Maintenance level management regimes will likely have to put less emphasis on thinning treatments and shift more toward treatments like uneven-aged selection harvesting and/or prescribed fire. Alternative D,

with its more aggressive thinning schedules within the moist upland forest, would be the least effective alternative for maintaining the desired conditions for stand densities within the moist upland forest over the 50-year timeframe. Under Alternative D, the total variation from desired conditions is projected to increase from 3 at year-20 to 10 points at year 50.

Umatilla National Forest Stand Density – Cold Upland Forest

The cold upland forest represents only about 10 percent of the Umatilla's forest landscape. With the existing condition showing a total variation from the historical range of variability of 23, it is currently only showing a low level of departure from the range of desired stand density conditions. The deviation from desired conditions stems from a modest excess of low-density stand conditions and a corresponding lack of high-density stands.

Table 294. Forest stand density class, as a percent of the cold upland forest potential vegetation group (with amount of variation from the desired condition range in parentheses) by alternative within the Umatilla National Forest

Alternative	Time Period	Cold/Open (Low density) DC = 20% – 30%	Cold/Closed (High density) DC = 65% - 80%	Summed Total Amount of Variation
Not applicable	Existing Condition	44% (14)	56% (9)	**(23)**
Alt. E-Modified	Year 20	40% (10)	60% (5)	**(15)**
Alt. E-Modified	Year 50	33% (3)	67% (0)	**(3)**
Alt. E-Modified Departure	Year 20	41% (11)	59% (6)	**(17)**
Alt. E-Modified Departure	Year 50	32% (2)	68% (0)	**(2)**
Alt. F	Year 20	36% (6)	64% (1)	**(7)**
Alt F.	Year 50	51% (21)	49% (16)	**(37)**
Alt. E	Year 20	45% (15)	55% (10)	**(25)**
Alt. E	Year 50	40% (10)	60% (5)	**(15)**
Alt. D	Year 20	39% (9)	60% (5)	**(14)**
Alt. D	Year 50	59% (29)	41% (24)	**(53)**
Alt. C	Year 20	35% (5)	65% (0)	**(5)**
Alt. C	Year 50	50% (20)	51% (14)	**(34)**
Alt. B	Year 20	35% (5)	65% (0)	**(5)**
Alt. B	Year 50	51% (21)	49% (16)	**(37)**
Alt. A	Year 20	34% (4)	65% (0)	**(4)**
Alt. A	Year 50	50% (20)	50% (15)	**(35)**

DC= desired condition

Alternatives A, B and C, all of which feature relatively low levels of active management, produce the best 20-year results. The degree of total variation for the cold upland potential vegetation group is expected to drop to around 4 to 5 points after 20 years for these three alternatives. However, looking at the mid-term timeframe shows the progress trend reversing across these three alternatives, and also within Alternatives D and F. The management regimes in these alternatives appear counterproductive in terms of achieving the desired conditions for stand density within the cold upland forest. However, Alternatives E-Modified and E-Modified Departure) show very different expected results in the mid-term, with desired conditions almost

achieved by year 50. Since these two alternatives assumed very little active management taking place within the cold upland forest, the results indicate lack major disturbance and/or active management may be mostly what is needed to address the desired conditions for more high-density stand conditions within the cold upland forest. Alternative D, with the most aggressive timber production schedule, would be the least effective alternative in achieving the desired conditions for stand densities within the cold upland forest. Under Alternative D, the total variation from desired conditions is projected to increase to 53 points over the 50-year timeframe.

Umatilla National Forest Stand Density – Dry Upland Forest

The dry upland forest makes up over half of the Umatilla's forest landscape. With the existing condition showing a total variation from the historical range of variability of 100, it is currently highly departed from the desired stand density conditions. The largest deviation exists in terms of an excess of high-density stand conditions and a corresponding lack of low-density conditions. With its ambitious objectives for thinning harvests, and focus on the dry upland forest, E-Modified Departure would likely make the most progress toward the desired conditions in the 20-year timeframe. This alternative would reduce the total variation from desired conditions to about 22 points within 20 years. Alternative D would be the next best option in the near term, as it would drop the dry upland forest's variation to 40 points. Alternative D would also produce the best results over the mid-term 50-year horizon. Alternative D would bring the potential vegetation group's current variation down to about 6 points over the 50-year time frame.

Table 295. Forest stand density class, as a percent of the dry upland forest potential vegetation group (with amount of variation from the desired condition range in parentheses) by alternative within the Umatilla National Forest

Alternative	Time Period	Dry/Open (Low density) DC = 80% – 90%	Dry/Closed (High density) DC = 5% - 20%	Summed Total Amount of Variation
Not applicable	Existing Condition	30% (50)	70% (50)	**(100)**
Alt. E-Modified	Year 20	54% (26)	46% (26)	**(52)**
Alt. E-Modified	Year 50	69% (11)	31% (11)	**(22)**
Alt. E-Modified Departure	Year 20	69% (11)	31% (11)	**(22)**
Alt. E-Modified Departure	Year 50	71% (9)	29% (9)	**(18)**
Alt. F	Year 20	47% (33)	53% (33)	**(66)**
Alt F.	Year 50	63% (17)	38% (18)	**(35)**
Alt. E	Year 20	51% (29)	49% (29)	**(58)**
Alt. E	Year 50	64% (16)	36% (16)	**(32)**
Alt. D	Year 20	60% (20)	40% (20)	**(40)**
Alt. D	Year 50	77% (3)	23% (3)	**(6)**
Alt. C	Year 20	39% (41)	61% (41)	**(82)**
Alt. C	Year 50	49% (31)	52% (32)	**(63)**
Alt. B	Year 20	45% (35)	55% (35)	**(70)**
Alt. B	Year 50	59% (21)	41% (21)	**(42)**
Alt. A	Year 20	46% (34)	54% (34)	**(68)**
Alt. A	Year 50	60% (20)	40% (20)	**(40)**

DC= desired condition

Alternatives A, B and C are all significantly less effective in terms of improving the stand density conditions of the dry upland forest. All of these alternatives would likely result in only modest levels of improvement in the near term. Alternative C would be the least effective option with total variation expected to drop to 82 and then 63 points over the 20-year and 50-year time horizons respectively. Allowing stand densities of the dry upland forest to move away from the desired conditions would likely result in continued risk of uncharacteristic severe wildfire as well as elevated susceptibility to insects or disease as high levels of inter-tree competition are allowed to persist.

Some of the alternatives, would put less emphasis on using mechanical treatments to reduce stand densities, and would instead, rely mainly on the use of fire (planned and unplanned ignitions) to manage stand densities. However, opportunities to utilize fire within stands already existing in a high-density condition would likely be limited by the risk of unintentionally causing undesirable high-severity effects. Pretreatment of these dense stands by mechanical means before utilizing prescribed fire would probably prove more effective than using fire alone (Kalies and Kent 2016).

Umatilla National Forest Stand Density – Moist Upland Forest

The Umatilla's moist upland forest component is significant, making up almost 40 percent of the overall forested landscape. With the existing condition showing a total variation from the historical range of variability of 30, it is currently moderately departed from the range of desired stand density conditions.

Table 296. Forest stand density class, as a percent of the dry upland forest potential vegetation group (with amount of variation from the desired condition range in parentheses) by alternative within the Umatilla National Forest

Alternative	Time Period	Moist/Open (Low density) DC = 30% – 40%	Moist/Closed (High density) DC = 60% - 80%	Summed Total Amount of Variation
Not applicable	Existing Condition	55% (15)	45% (15)	**(30)**
Alt. E-Modified	Year 20	39% (0)	61% (0)	**(0)**
Alt. E-Modified	Year 50	30% (0)	70% (0)	**(0)**
Alt. E-Modified Departure	Year 20	43% (3)	57% (3)	**(6)**
Alt. E-Modified Departure	Year 50	31% (0)	69% (0)	**(0)**
Alt. F	Year 20	36% (0)	64% (0)	**(0)**
Alt F.	Year 50	38% (0)	62% (0)	**(0)**
Alt. E	Year 20	42% (2)	58% (2)	**(4)**
Alt. E	Year 50	36% (0)	64% (0)	**(0)**
Alt. D	Year 20	41% (1)	59% (1)	**(2)**
Alt. D	Year 50	49% (9)	51% (9)	**(18)**
Alt. C	Year 20	35% (0)	65% (0)	**(0)**
Alt. C	Year 50	36% (0)	64% (0)	**(0)**
Alt. B	Year 20	35% (0)	65% (0)	**(0)**
Alt. B	Year 50	37% (0)	63% (0)	**(0)**
Alt. A	Year 20	35% (0)	65% (0)	**(0)**
Alt. A	Year 50	39% (0)	61% (0)	(0)

DC= desired condition

All of the alternatives show the ability to either achieve or come close to achieving conditions close to the historical range over the next 20 years. However, looking at the mid-term timeframe shows the progress trend reversing itself to some extent for Alternative D. While all of the other alternatives would achieve and maintain the desired conditions over the 50-year time horizon, the management regime of Alternative D appears to be counterproductive over the 50-year time horizon. These results suggest that management regimes designed to effectively maintain desired conditions will necessarily be different from active restoration programs. Maintenance level management regimes will likely have to put less emphasis on thinning treatments and shift more toward treatments like uneven-aged selection harvesting and/or prescribed fire. Alternative D, with its more aggressive thinning schedules within the moist upland forest, would be the least effective alternative for maintaining the desired conditions for stand densities within the moist upland forest over the 50-year timeframe. Under Alternative D, the total variation from desired conditions is projected to increase from 2 at year-20 to 18 points at year 50.

Wallowa-Whitman National Forest Stand Density – Cold Upland Forest

The cold upland forest represents over 25 percent of the Wallowa-Whitman's forest landscape, and much of the cold upland forest potential vegetation group is located within existing or proposed wilderness, roadless or backcountry areas.

Table 297. Forest stand density class, as a percent of the cold upland forest potential vegetation group (with amount of variation from the desired condition range in parentheses) by alternative within the Wallowa-Whitman National Forest

Alternative	Time Period	Cold/Open (Low density) DC = 20% – 30%	Cold/Closed (High density) DC = 65% - 80%	Summed Total Amount of Variation
Not applicable	Existing Condition	62% (32)	38% (27)	(59)
Alt. E-Modified	Year 20	51% (21)	49% (16)	(37)
Alt. E-Modified	Year 50	38% (8)	62% (3)	(11)
Alt. E-Modified Departure	Year 20	51% (21)	49% (16)	(37)
Alt. E-Modified Departure	Year 50	39% (9)	61% (4)	(13)
Alt. F	Year 20	48% (18)	51% (14)	(32)
Alt F.	Year 50	47% (17)	53% (12)	(29)
Alt. E	Year 20	50% (20)	50% (15)	(35)
Alt. E	Year 50	50% (20)	50% (15)	(35)
Alt. D	Year 20	52% (22)	48% (17)	(39)
Alt. D	Year 50	51% (21)	49% (16)	(37)
Alt. C	Year 20	48% (18)	52% (13)	(31)
Alt. C	Year 50	46% (16)	54% (11)	(27)
Alt. B	Year 20	48% (18)	52% (13)	(31)
Alt. B	Year 50	46% (16)	53% (12)	(28)
Alt. A	Year 20	48% (18)	52% (13)	(31)
Alt. A	Year 50	47% (17)	53% (12)	(29)

DC= desired condition

With the existing condition showing a total variation from the historical range of variability of 59, it is significantly departed from the range of desired stand density conditions. The deviation from desired conditions stems from a large excess of low-density stand conditions and a corresponding lack of high-density stands. Under all of the alternatives, fairly similar levels of significant progress toward increasing the proportion of high-density stands in the cold upland forest are expected within 20 years. The best 20-year results are expected under Alternatives A, B and C, which feature relatively low levels of active management. The degree of variation for the cold upland potential vegetation group is expected to drop to around 31 points after 20 years for these three alternatives. Looking at the mid-term timeframe shows that across Alternatives A through F, progress either slows dramatically, or stops completely. However, Alternatives E-Modified and E-Modified Departure show very different expected results in the mid-term, with continued progress toward desired conditions expected to be achieved by year 50. Since these two alternatives assumed very little active management taking place within the cold upland forest, the results indicate lack major disturbance and/or active management may be mostly what is needed to address the desired conditions for more high-density stand conditions within the cold upland forest potential vegetation group.

Wallowa-Whitman National Forest Stand Density – Dry Upland Forest

The dry upland forest makes up about one-half of the Wallowa-Whitman's forest landscape. With the existing condition showing a total variation from the historical range of variability of 96, it is currently highly departed from the desired stand density conditions. The largest deviation is an excess of high-density stand conditions and a corresponding lack of low-density conditions. With its ambitious objectives for thinning harvests, and focus on the dry upland forest, E-Modified Departure would likely make the most progress toward the desired conditions in the 20-year timeframe. This alternative would reduce the total variation from desired conditions to about 18 points within 20 years. Alternatives D and E-Modified would be the next best options in the near term, as they would drop the dry upland forest's variation to 44 to 46 points. Despite the indicated differences in near term performance, all three of these alternatives would seem likely to result in similar levels of progress over the mid-term 50-year horizon. They would bring the potential vegetation group's current variation to between 6 to 10 points over the 50-year time frame.

Alternatives A, B, C and F are all significantly less effective in terms of improving the stand density conditions of the dry upland forest. All of these alternatives would likely result in only modest levels of improvement in the near term. Alternative C would be the least effective option with total variation expected to drop only to 82 and then 68 points over the 20-year and 50-year time horizons respectively. Allowing stand densities of the dry upland forest to move away from the desired conditions would likely result in continued risk of uncharacteristic severe wildfire as well as elevated susceptibility to insects or disease as high levels of inter-tree competition are allowed to continue.

Some of the alternatives, would put less emphasis on using mechanical treatments to reduce stand densities, and would instead, rely mainly on the use of fire (planned and unplanned ignitions) to reduce stand densities. However, opportunities to utilize fire within stands already existing in a high density condition would likely be limited by the risk of unintentionally causing undesirable high-severity effects. Pretreatment of these dense stands by mechanical means before utilizing prescribed fire would probably prove more effective than using fire alone (Kalies and Kent 2016).

Table 298. Forest stand density class, as a percent of the dry upland forest potential vegetation group (with amount of variation from the desired condition range in parentheses) by alternative within the Wallowa-Whitman National Forest

Alternative	Time Period	Dry/Open (Low density) DC = 80% – 90%	Dry/Closed (High density) DC = 5% - 20%	Summed Total Amount of Variation
Not applicable	Existing Condition	32% (48)	68% (48)	**(96)**
Alt. E-Modified	Year 20	58% (22)	42% (22)	**(44)**
Alt. E-Modified	Year 50	75% (5)	25% (5)	**(10)**
Alt. E-Modified Departure	Year 20	71% (9)	29% (9)	**(18)**
Alt. E-Modified Departure	Year 50	75% (5)	25% (5)	**(10)**
Alt. F	Year 20	46% (34)	54% (34)	**(68)**
Alt F.	Year 50	59% (21)	41% (21)	**(42)**
Alt. E	Year 20	52% (28)	48% (28)	**(56)**
Alt. E	Year 50	69% (11)	31% (11)	**(22)**
Alt. D	Year 20	57% (23)	43% (23)	**(46)**
Alt. D	Year 50	77% (3)	23% (3)	**(6)**
Alt. C	Year 20	39% (41)	61% (41)	**(82)**
Alt. C	Year 50	46% (34)	54% (34)	**(68)**
Alt. B	Year 20	44% (36)	56% (36)	**(72)**
Alt. B	Year 50	56% (24)	44% (24)	**(48)**
Alt. A	Year 20	44% (36)	56% (36)	**(72)**
Alt. A	Year 50	56% (24)	44% (24)	**(48)**

DC= desired condition

Wallowa-Whitman National Forest Stand Density – Moist Upland Forest

The Wallowa-Whitman’s moist upland forest component makes up about one quarter of the overall forest landscape. With the existing condition showing a total variation from the historical range of variability of 2, it is currently essentially within the range of desired conditions for stand density. All of the alternatives show the ability to maintain conditions close to the historical range over the next 20 years. However, looking at the mid-term timeframe shows the progress trend reversing itself to some extent for Alternatives D, E, E-Modified and E-Modified Departure. The management regimes in these alternatives appear counterproductive in terms of maintaining the desired conditions for stand density within the moist upland forest over the 50-year time horizon. The results for these four alternatives suggest that management regimes designed to effectively maintain desired conditions will necessarily be different from active restoration programs. Maintenance level management regimes will likely have to put less emphasis on thinning treatments and shift more toward treatments like uneven-aged selection harvesting and/or prescribed fire. Alternatives E and D, with more aggressive thinning schedules within the moist upland forest, would be the least effective alternatives for maintaining the desired conditions for stand densities within the moist upland forest over the 50-year timeframe. Under Alternatives D and E, the total variation from desired conditions is projected to increase from zero at year 20 to 26 and 18 points respectively at year 50.

Table 299. Forest stand density class, as a percent of the moist upland forest potential vegetation group (with amount of variation from the desired condition range in parentheses) by alternative within the Wallowa-Whitman National Forest

Alternative	Time Period	Moist/Open (Low density) DC = 30% – 40%	Moist/Closed (High density) DC = 60% - 80%	Summed Total Amount of Variation
Not applicable	Existing Condition	41% (1)	59% (1)	**(2)**
Alt. E-Modified	Year 20	41% (1)	59% (1)	**(2)**
Alt. E-Modified	Year 50	46% (6)	54% (6)	**(12)**
Alt. E-Modified Departure	Year 20	41% (1)	59% (1)	**(2)**
Alt. E-Modified Departure	Year 50	46% (6)	54% (6)	**(12)**
Alt. F	Year 20	29% (1)	71% (1)	**(2)**
Alt F.	Year 50	43% (3)	57% (3)	**(6)**
Alt. E	Year 20	33% (0)	66% (0)	**(0)**
Alt. E	Year 50	49% (9)	51% (9)	**(18)**
Alt. D	Year 20	36% (0)	64% (0)	**(0)**
Alt. D	Year 50	53% (13)	47% (13)	**(26)**
Alt. C	Year 20	26% (4)	74 (0)	**(4)**
Alt. C	Year 50	39% (0)	61% (0)	**(0)**
Alt. B	Year 20	28% (2)	72% (0)	**(2)**
Alt. B	Year 50	41% (1)	59% (1)	**(2)**
Alt. A	Year 20	28% (2)	72% (0)	**(2)**
Alt. A	Year 50	42% (2)	58% (2)	**(4)**

DC= desired condition

Cumulative Effects

Potential cumulative effects were analyzed by considering the effects of the alternatives in the context of past, present (ongoing), and reasonably foreseeable future activities that have occurred within the vegetation cumulative effects analysis area. This analysis area consists of the 25 subbasins (HUC 4) which contain the Malheur, Umatilla, and Wallowa-Whitman National Forests and other lands. The time period into the future considered was 50 years. Present and foreseeable future activities that could affect forest vegetation are summarized below:

The three National Forests of the Blue Mountains region are revising their Forest Plans simultaneously. These three individual final revised Forest Plans will all contain the same desired conditions and will emphasize forest vegetation treatments that change the species composition, density, and structure in a similar fashion. With these three National Forests adjoining one another, the management direction established with these final revised Forest Plans should promote coordinated efforts that will complement each other in contributing to overall movement toward the historical range of variability and desired conditions for the restoration of landscape resiliency.

The vast majority of the forestland within the Plan Area is federally managed by one of the three National Forests. Most of the other forestland within and adjacent to the National Forests is either owned by private individuals or forest products companies, with a small amount being managed by tribal governments or other federal agencies like the Bureau of Land Management. Timber harvesting and many other related silvicultural treatments on forestlands of other ownership are

controlled by State forest practices statutes, as well as a number of State and Federal regulations and incentives designed to protect the productivity and environmental quality of natural resources. The Forest Service does not have the authority to regulate any activities or their timing on lands other than those they administer.

Management objectives on these forestlands of other ownership tend to focus on fuel reduction and timber production. These ownerships also tend to be concentrated within the dry upland forest areas. The historical harvesting practices of that took place on these lands were similar to that which occurred on the National Forest. As a result, much of the old forest structure of these areas has been previously harvested, and these lands contribute little of this structural stage to the overall landscape. Habitats for whitebark pine and aspen on lands of other ownership are very limited. Management practices on adjacent forestlands, which focuses on maintaining low-density stand conditions to accelerate sawtimber production or reduce the risk of severe fire behavior, tend to make it less likely that severe wildland fire or insect outbreaks will develop outside the National Forest and subsequently move onto National Forest System lands.

Land uses, subdivision, and development of privately owned forestland within the wildland-urban interface is expected to continue to occur only at modest rates and is not expected to significantly affect current conditions within the National Forest over the planning horizon.

Actions or the lack of actions that may take place under the various alternatives on National Forest System lands may cause direct, indirect or cumulative effects on adjacent lands of other ownership. If the conditions of the National Forest forestlands are conducive, insect outbreaks or wildfires that typically start small in one or more localized places within the National Forests may spread subsequently to additional areas. The effects of these disturbances have the potential to spread to and negatively impact adjacent ownerships if large areas within the National Forests contain the same host tree species or contain uncharacteristically high forest fuel loads. If disturbances develop to a high enough level within the National Forests as a result of favorable conditions, the resulting effects could become so great that they are able to overwhelm adjacent ownerships, even though those areas had received preventative treatment.

Over much of last planning period, forest restoration efforts in the Blue Mountains have focused on addressing a long legacy of fire exclusion and historical timber harvesting practices that have created densely stocked stands, mostly at lower elevations. Active management has centered on improving the vigor of low-elevation dry forests and reducing fire hazard, primarily with mechanical treatments and prescribed fire.

The level of active silvicultural management over the past planning period has largely been insufficient to reverse most of the undesirable conditions discussed in the previous sections. The abundance of relatively small-scale active management projects has contributed to a growing backlog of excess forest growth and continued movement away from the historical range of variability. One notable exception to this pattern has been the award of a large-scale 10-year Integrated Resource Service Contract by the Malheur National Forest in 2013. This 10-year contractual obligation to supply substantial volumes of timber has enabled a pace and scale of treatment that has not been utilized since early in the previous planning period. This project could provide additional momentum to the planning and implementation of forest management projects by the Malheur National Forest for at least the remaining term of the contract. As the service contract expands through subsequent annual task orders, a level of certainty is likely to continue to develop for local contractors, encouraging their investment in the infrastructure necessary to fully accomplish needed restoration work across the Malheur and other eastside Oregon forests.

However, establishment of a small diameter market to sustain the critical work to restore stand structure and composition, along with the continuation of elevated funding levels, will both be key elements in sustaining this effort beyond the life of this initiative.

The greatest extent of foreseeable actions connected to the attainment of future forest-restoration goals is related to the ongoing Eastside Restoration Strategy. This effort, supported by the Pacific Northwest Regional office of the Forest Service, started in 2013 as a way of putting resources toward and a focus on some different methods of planning and implementing forest restoration projects on the eastside National Forests of Oregon and Washington. Since 2013, the effort has supported the development of five Collaborative Forest Landscape Restoration Projects and five Joint Chief's projects, which combine the forces of the Forest Service and the Natural Resources Conservation Service to restore forests and reduce fuel loadings across adjoining Federal and non-Federal lands in priority areas. The Blue Mountains Restoration Team has recently completed the Lower Joseph Creek Restoration Project Final Environmental Impact Statement and the Record of Decision for that implementation project was finalized in March of 2017. The same team is currently working on the landscape scale Blue Mountains Forest Resiliency Project, which encompasses parts of three National Forests in the Blue Mountains of Oregon and may cover up to 610,000 acres of thinning and prescribed fire treatments. All of these planning efforts will tend to support the future implementation of the revised Forest Plans.

Other efficiencies, such as the regional Aquatic Restoration Biological Opinion covering the Pacific Northwest and streamlining consultation for projects working within those design criteria, have provided a vehicle for increasing riparian restoration efforts throughout the region.

The National Forests within the Blue Mountains have all implemented some levels of active restoration efforts for whitebark pine over the previous planning period. All of the alternatives for plan revision would contain desired conditions for whitebark pine to persist on the landscape, so restoration activities for this species would likely continue or intensify, contingent upon funding. If this tree species is eventually listed as a Federal threatened or endangered species, there could be ramifications to the vegetation and fire management programs within the Blue Mountains national forests due to additional legal requirements to ensure individual whitebark pines are not adversely affected or destroyed by either whitebark pine restoration actions or fire suppression activities.

Carbon Sequestration

The movement of carbon between the earth and its atmosphere controls the concentration of carbon dioxide in the air. Carbon dioxide is important because it is a greenhouse gas and traps heat radiation given off when the sun warms the earth. Higher concentrations of greenhouse gases in the atmosphere can cause the earth to warm. Forests store large amounts of carbon in their live and dead wood and soil and play an active role in controlling the concentration of carbon dioxide in the atmosphere (Ryan et al. 2010). Carbon fluxes between the atmosphere and forests are complex, and vary spatially and temporally. The cycle of forest growth, death, and regeneration and the use of wood removed from the forest complicate efforts to understand and measure forest carbon pools and flows. The Malheur, Umatilla, and Wallowa-Whitman National Forests store and sequester approximately 13 percent of the total Pacific Northwest Region carbon and carbon dioxide (Heath et al. 2011).

Factors that could potentially influence whether carbon stocks shift from regional carbon sinks to carbon sources include increasing temperatures, changes in precipitation, changing disturbance regimes, such as more frequent fires, and degradation of forest resiliency that results in net

decreases of forested areas. Fire and bark beetle outbreaks play a large role in regional carbon balances. The current forests of the Blue Mountains are developing, and to some extent, recovering from past management practices. Because this period of recovery will eventually end, the resulting forest carbon sink will not continue indefinitely. Increased fertilization from atmospheric nitrogen deposition and increased atmospheric carbon dioxide may also be contributing to forest growth. Both the magnitude of this growth and the future of the carbon sink over the next 50 years are uncertain.

Under simulations, eastern Oregon gains ecosystem carbon because of the expansion of forest and woodland vegetation, while experiencing more and larger wildfires at the same time (Millar et al. 2006). However, deforestation, or the conversion of forest land to nonforest cover types, for example, by abnormally large and severe wildfires, could have a significant impact on global carbon dioxide emissions. Consequently, the different approaches represented in the plan revision alternatives could have long-term implications in terms of the potential for carbon sequestration.

As explained by Ryan et al. (2010), the various strategies for storing carbon in forests have different associated risks and levels of uncertainty. Retaining forests (which also includes regenerating after disturbances) and afforestation both involve low levels of uncertainty regarding carbon consequences and therefore low risk to carbon storage—aside from the risks of carbon loss in disturbance or that the deforestation will simply happen elsewhere. The carbon benefits of using biomass energy and long-lived forest products are also fairly certain, as long as forests regenerate. Reducing harvest levels or lengthening harvest intervals involves a bit more risk because disturbances would be more likely to occur in forests with higher carbon stores.

Timber and Forest Products

Timber management and harvesting is an important tool for managing tree growth and yields, ecosystem diversity, forest insect and disease populations, recreation settings, wildlife habitat, and wildfire hazard. Timber harvesting provides forest products that help support local forest dependent industries and the communities associated with those industries. It helps meet the demands of the public for products such as lumber, pulpwood, firewood, house logs or other forms of roundwood. It can also influence the availability and harvesting of special forest products.

This section provides an estimate of lands suitable for timber production, harvesting levels in relation to long-term sustained yield and allowable sale quantity volume. The timber volumes expected to be removed from lands both suitable and not suitable for timber production are estimated (timber sale program quantity). The forest products that could be removed from the dry upland forest, moist upland forest and cold upland forest potential vegetation groups are considered.

Changes Made Between the Draft and Final Environmental Impact Statements

Aside from the global changes throughout this Environmental Impact Statement described in the Preface to this document (see Volume 1), the following changes were made specifically to this section:

Improvements in the Methods Used to Estimate Timber Yields Associated with Harvest Treatments: Forest Service received numerous comments on the Draft Plan and Environmental

Impact Statement that expressed concerns over what was perceived as insufficient timber volume estimates for allowable sale quantity and timber sale program quantity. In response to these comments, the methodology behind the calculation of the estimated timber yields used to calculate these volumes was improved. As a result, all of the Draft Environmental Impact Statement timber volumes, for all alternatives, have been revised. The explanation of the methods used to calculate the yields has been clarified and brought forward from its previous location in an appendix of the Draft Environmental Impact Statement.

Acres of Harvest Treatment as a Key Indicator: The description of harvesting effects that was contained within this section of the Draft Environmental Impact Statement was moved to the "Ecological Resilience" section of the Final Environmental Impact Statement. This was done to improve clarity and readability. Because harvesting treatment acres have already been included and discussed as a key indicator within the previous "Ecological Resilience" section, removing the same material here eliminates redundancy. This discussion topic was also strengthened within the "Ecological Resilience" section to improve clarity and respond to comments questioning the role of various silvicultural treatments in terms of enhancing ecological resilience.

Update of Past Timber Harvesting Levels: The figure representing levels of past timber harvesting in the "Affected Environment" section (Figure 40) was updated to show more relevant and timely information. The figure now portrays the quantity of timber volumes sold by the three National Forests from 2007 to 2016.

Revision of Tables Presenting Long-term Sustained Yield, Allowable Sale Quantity, and Timber Sale Program Quantity: Between the development of the draft and Final Environmental Impact Statements, the tables presenting the long-term sustained yield, allowable sale quantity, and timber sale program quantity values were revised. This was done to more clearly compare and relate allowable sale quantity to long-term sustained yield for a given alternative, and also to show what portion of the timber sale program quantity volume was contributed by harvesting on lands suitable for timber production and what portion is estimated to come from other lands.

Key Assumptions and Methodology

Forest product volumes resulting from harvesting treatments were estimated based on the forest vegetation modeling completed with the Vegetation Dynamics Development Tool. See the "Forest Vegetation" section for more information concerning how that modeling was completed. Timber volume yield factors were applied against the model's harvest acres output to generate total volume estimates for the different alternative values of long-term sustained yield, allowable sale quantity, and timber sale program quantity. Tables of timber harvest volume yields were developed by performing various simulated harvest prescriptions within the Blue Mountains variant of the Forest Vegetation Simulator model (Dixon 2002, 2008). Plot data from the existing forest Continuous Vegetation Survey inventory were categorized in terms of the various Vegetation Development Dynamics Tool model for vegetation classes. All of these various forest vegetation classes were then harvested within the Forest Vegetation Simulator model via several different prescription types, which represented common expected treatments (such as commercial thinning, individual tree selection, shelterwood or regeneration harvests). This resulted in an estimated yield of merchantable timber expected for each vegetation class/harvest prescription combination. Total volume estimates were then generated by multiplying the total acres of each specific vegetation state class treated with a particular harvest prescription, times the associated estimated yield.

Distinct Forest Vegetation Simulator harvest prescriptions were developed for each national forest based on their different minimum merchantability standards. Alternative C is the only alternative to propose a strict harvesting diameter limit of 21 inches, while Alternative A would continue the portions of the Eastside Screens direction related to old forest. Because many stages of old forest are currently underrepresented on the landscape, Alternative A will also effectively result in the imposition of a diameter cap requiring the retention of most live trees greater than 21 inches diameter. All the other alternatives were designed to implement more flexible approaches to old forest conservation. Therefore, different versions of harvest scenarios were also developed to represent harvesting under a strict 21-inch diameter limit, as well as harvesting under scenarios that would allow degrees of flexibility in that regard. The Forest Vegetation Simulator harvest component key files ("kcp" files) with the strict diameter cap built in were used in conjunction with allowable sale quantity and timber sale program quantity modelling for Alternatives A and C. All long-term sustained yield modelling as well as all other alternative versions of allowable sale quantity and timber sale program quantity used the volume yields derived from the harvest scenarios without a strict diameter limit.

Other assumptions used with the alternatives modelling include:

- All harvest schedules were designed with consideration of moving toward the overall desired conditions for forest vegetation structure, density and species composition.
- Because of the recognized scarcity of old forest structure stages in terms of the desired conditions, only uneven-aged management or thinning harvests were modelled within these stands.
- Markets were assumed to continue to exist for all products meeting minimum merchantability specifications and the full suite of implementation tools was assumed to be available including stewardship contracting.
- Firewood, Christmas trees, post and poles, transplants and other personal use products will continue to be available to meet public demand. Amounts will be similar to current levels and will not vary between alternatives.

Timber and Forest Products – Affected Environment

The Blue Mountains National Forests have a long history of providing timber and other forest products to address local community, regional and national needs. Commercial logging began in the 1870s when the transcontinental railroad linked the Blue Mountains to national lumber markets. Logging accelerated during the 1890s. Timber companies extended railroad lines into several drainages and sawmills began to appear across the Blue Mountains (Wickman 1992). With the establishment of the national forests, harvest slowed on public lands. National forest timber was difficult to access and more costly to acquire. From 1905 until 1916, most commercial timber harvest in the Blue Mountains came from private lands. This situation changed in the 1920s. National forests began offering large timber sales that focused on removal of commercially valuable stands of old ponderosa pine. Heavy logging occurred throughout the decade and was only abated by the drop in the national economy and the oversupply of lumber that occurred in the 1930s (Langston 1995). Logging on the national forests increased again in the 1940s. During the post-World War II era, communities throughout the Plan Area generally had robust economies related in part to a flourishing wood products industry. Harvest levels remained relatively high throughout the next four decades (1950s through 1980s) as forest managers raced to salvage insect-killed timber and provide lumber for a growing national market.

From its beginning, management of the National Forests emphasized efficient and productive forests capable of meeting the nation's demands into the future. The emerging discipline of American forestry at the time held that inferior diseased and decadent trees needed to be removed and replaced with young, healthy, rapidly growing trees. Generally, this meant replacing stands of slower growing, old ponderosa pine with young, faster growing stands. Logging of ponderosa pine was so intense during the logging boom that started in the 1920s that it likely exceeded sustainable rates. For example, two large timber sales from the Malheur National Forest made 2 billion board feet of pine available out of an estimated supply of 7 billion board feet in the forest. As harvest of large, old ponderosa pine continued, the availability of large desirable pine sawlog trees gradually decreased on the three National Forests. The average ponderosa pine harvested from the Wallowa-Whitman National Forest in 1912 was 33 inches in diameter at breast height. By 1992, the average size harvested was 19 inches diameter. The quantity of ponderosa pine harvested also decreased over time. In the Wallowa-Whitman National Forest, 57 percent of the timber by volume in 1906 was ponderosa pine; in 1991, ponderosa pine volume was less than 20 percent. From the Umatilla National Forest, ponderosa pine was 34 percent of the harvest volume in 1931 (Weidman and Silcox 1936) and 16 percent in 1981.

Sharp declines in timber harvesting from federal lands in the Blue Mountains have occurred since the 1990s. These declines have primarily been due to federal management changes intended to protect wildlife species and encourage the growth of older forests. The amount of timber volume harvested from the three Blue Mountains National Forests has declined dramatically during the previous planning period, from highs of almost 600 million board feet annually in the early 1990s to a current 3-year average annual volume sold of around 100 million board feet. Harvest on all other ownerships has also declined by about 30 percent during the same period, for a total decline of about 70 percent in local log supply.

Figure 40 displays commercial timber sold volume (personal use permit volumes are not included) from the Malheur, Umatilla and Wallowa-Whitman National Forests from fiscal years 2007 to 2016.[6] The average annual volume sold has declined significantly from 1990 Forest Plans' projected average for the Blue Mountains of 576 million board feet per year to the current 3-year average annual volume sold of around 100 million board feet per year. The use of even-aged regeneration methods of timber harvest (clearcut, seed tree, and shelterwood) has been reduced to less than 5 percent of the acres that were projected in the1990 Forest Plans.

Declines in eastern Oregon Federal timber harvest resulted in substantial reductions in east-side volume delivered to Oregon mills over the past 20 years, particularly for ponderosa pine. Unlike other regions within the State, in eastern Oregon there is relatively little privately held or State forest land to make up for reduced Federal harvesting (Gale et al. 2012). During the past 20 years, processing for wood products has also changed. There was a decrease in sawmill production of almost 60 percent. The processing of "manufactured" board products also decreased by approximately 30 percent. There was a reduction in plywood and veneer processing of about 10 percent, while pulp processing remained has about the same.

[6] Source: U.S. Forest Service Timber Information Manager PTSAR (Administrative Unit Summary) - PTSR202F reports (excluding personal use permit volume)

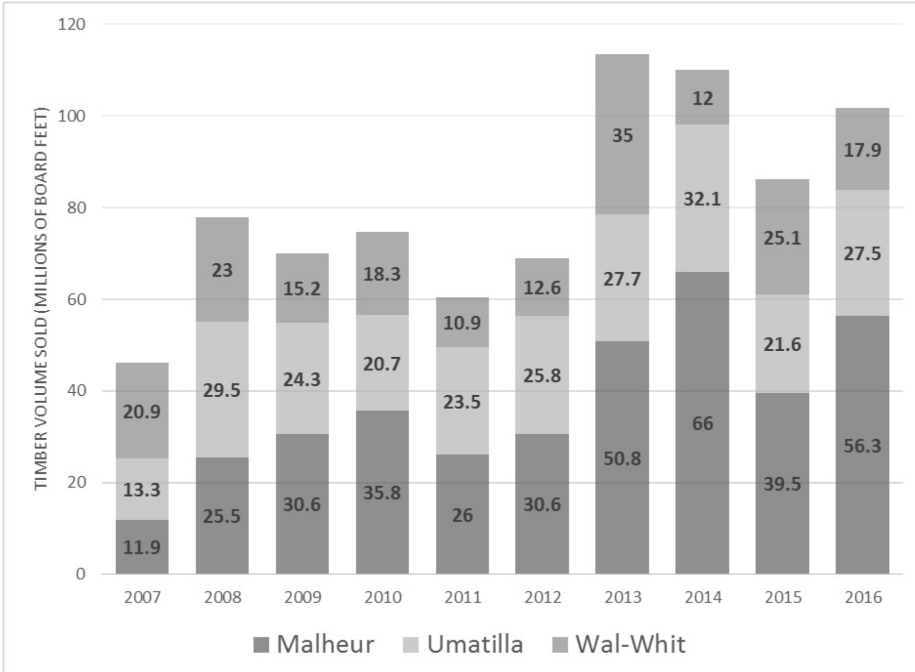

Figure 40. National Forest commercial timber volume sold[1] over the previous 10 fiscal years

The decreasing production capacity, labor saving technological changes, and decreases in logging have resulted in declines for associated employment. Timber-based businesses have been closing and the region has lost valuable forestry infrastructure such as mills, logging equipment and expertise. There have been unintended social and economic consequences as well, including loss of receipts from timber sales used to support roads and schools (OFRI 2010). More recently, since the bottom of the recession of 2009, the forest sector in Oregon has been slowly recovering. However, certain parts of the Blue Mountains region have been impacted so severely that it is now possible that recovery will be years away. The share of jobs lost during the recession that have since been regained, remains at only one of three or fewer for many affected counties (Kaetzel 2015). A more detailed discussion of social and economic considerations can be found in the “Social and Economic Well Being” section of Chapter 3.

Although some economic diversification has taken place, wood products manufacturing remains an important part of local economies. There is expanding use and interest in biomass for fuels. Timber management continues to be an important tool for managing vegetation to achieve desired conditions, including those for wildlife, climate change, and wildland fire management. Without the local timber products industry, the capability of the Forest Service to affordably manage vegetation would be significantly reduced. A more detailed discussion of how timber harvesting is used to improve the forest conditions can be found in the “Ecological Resilience” section of Chapter 3 in volume 1.

The three Blue Mountains National Forests have also contributed nontimber forest products, such as firewood, mushrooms, posts, and poles to residents and Tribes. For example, in fiscal year 2016, the National Forests sold about $148,000 of firewood permits, $46,000 of mushroom collection permits, and about $9,000 of post and pole permits. These uses help provide communities with heat and food, and also represent important connections between people and the National Forests.

Growth and Mortality

Hovee et al. (2005) noted that mortality is substantially higher on public rather than private lands in eastern Oregon, and on federal lands, mortality far exceeds harvest removals. This same study estimated net forest growth (gross growth minus mortality) for eastern Oregon of around 800 million board feet per year. An analysis of two different data collection occasions of continuous vegetation survey plot data indicated a similar annual net growth rate. Across the Blue Mountains national forests, the annual gross forest growth and net forest growth have far exceeded harvesting levels. These high levels of net growth combined with low levels of harvest removals may jeopardize long-term timber resource as well as ecosystem health in general. Excess forest growth is currently being removed through competition related mortality, insect and disease outbreaks, and wildfires. This growing surplus needs to be removed in a controlled manner to move toward and maintain the desired conditions for forest vegetation and timber production. Overgrowth reduces individual tree growth, vigor, and may contribute to uncharacteristically severe wildfire or insect outbreaks (Raffa et al. 2008; Stine et al. 2014; Millar and Stephenson 2015).

Lands Tentatively Suitable for Timber Production

The National Forest Management Act requires that National Forest System lands be classified as to their suitability and availability for timber harvest and production. Since the adoption of the 1990 Forest Land and Resource Management Plans, many changes to timber production suitability have occurred. These changes include reductions in lands considered suitable for timber production due to Forest Plan amendments resulting in major shifts in management direction pertaining to riparian areas and old forest. The final adoption of Federal regulations for the protection of inventoried roadless areas (36 CFR 294) also resulted in large areas no longer being suitable for timber production. As part of the forest plan revision, timber suitability was re-calculated to reflect these changes in management direction. Lands suitable for timber production form the basis for the calculation of the allowable sale quantity and the long-term sustained yield capacity. The first step of the suitability determination is to identify the lands that are tentatively (potentially) suitable for timber production.

A timber suitability analysis following the requirements of the National Forest Management Act was completed as a part of the planning process. This process is basically a series of subtractions of land from the total forest land base using the following four broad categories to identify lands not available for timber production:

1. National Forest System lands that have been withdrawn from timber production. These are lands designated by Congress, the Secretary of Agriculture, or the Chief of the Forest Service for other multiple-use objectives that preclude timber production (such as units of the National Wilderness Preservation System and research natural areas).
2. National Forest System lands (exclusive of withdrawn areas) that are not forested, or are not capable of producing industrial wood, including lands that are incapable of supporting 10 percent tree cover or support less than 20 cubic feet per acre per year; administrative sites; and lands maintained in a nonforest condition, such as powerline rights-of-way.
3. Forestland physically unsuited for timber production because technology is not available to ensure timber production from the land without causing irreversible damage to soils productivity, or watershed conditions.

4. Forestland for which there is a lack of reasonable assurance that adequate restocking can be attained within five years following regeneration harvesting.

Forestlands remaining after identifying and subtracting these subsets of unsuitable forestlands described above are those that are tentatively available for and potentially capable of timber production. These are referred to as tentatively suitable forestland. Tentatively suitable forestlands represent the maximum number of acres that could be managed for regular and predictable wood product outputs (timber production). These acres remain constant as a starting point for the development of different alternatives. Table 300 displays lands tentatively suitable for timber production by national forest. See the comparison of alternatives in the "Environmental Consequences" section below for a display of suitable acres for each alternative.

Table 300. Lands tentatively suitable for timber production

Category	Malheur	Umatilla	Wallowa-Whitman
1. NFS lands total (acres)	**1,700,000**	**1,400,000**	**1,800,000**
a. Forest land withdrawn from production	101,000	347,000	390,000
b. Non-forest land	215,000	199,000	250,000
c. Potential for irreversible damage	0	0	0
d. No assurance of adequate restocking	139,000	37,000	150,000
2. Total unsuitable land (acres)	455,000	583,000	790,000
3. Tentatively suitable forest land (acres)	1,245,000	817,000	1,010,000

Long-term Sustained Yield

Long-term sustained yield is the maximum amount of timber volume that can be sustainably harvested from the lands suitable for timber production under a specific management regime consistent with other multiple-use objectives. The key difference between long-term sustained yield and the allowable sale quantity (see below) is that long-term sustained yield is estimated under the assumption that the lands suitable and managed for timber production exist in a fully managed regulated state and the forest vegetation meets desired conditions. Allowable sale quantity, on the other hand, is constrained to the time period covered by the plan, so it will reflect yields from lands in their current condition that do not exist within the desired conditions. Otherwise, the same Vegetation Development Dynamics Tool model was used to project both the long-term sustained yield and allowable sale quantity. The forest growth assumptions, suitable timber production land base, utilization standards and yield tables used were the same for both long-term sustained yield and allowable sale quantity for any given alternative, with two exceptions. As discussed above, the yield tables used to determine the allowable sale quantity for Alternatives A and C reflect a strict 21-inch diameter limit. However, for the determination of long-term sustained yield, it was assumed that the forest vegetation was within our desired conditions, so this management direction would no longer be needed. Generally, long-term sustained yield was estimated to represent the harvest of the annual net growth from forest lands suitable for timber production, assuming those lands are meeting our desired ecological conditions and are fully managed. All long-term sustained yield modelling, for all alternatives, used the volume yields derived from the harvest scenarios without a strict diameter limit.

The Vegetation Development Dynamics Tool was used to estimate the long-term sustained yield for each alternative. Multiple model runs were performed for each alternative's long-term

sustained yield to smooth the random variation of the modeling results. The models were first run for a 200-year period, to ensure all potential vegetation groups were within the desired conditions. Multiple iterations were then run for the period from year 201 to 300 and the results were paired up with the appropriate timber volume yield tables. The final solution for each alternative's long-term sustained yield is the average of multiple simulations over the 201 to 300-year model period. The end results represent the highest level of timber volume output that was able to produce a steady timber volume trend line over the modeled period while also maintaining the desired vegetation conditions over the entire period. These values were presented as average annual volume amounts for each alternative.

Allowable Sale Quantity

Allowable sale quantity is the quantity of timber that may be sold from the land area that is designated as suitable for timber production. The allowable sale quantity volume control concept enacted by the National Forest Management Act was intended to prevent overcutting beyond sustainable forest levels from occurring on suitable timberlands. The allowable sale quantity is the upper limit of the amount of timber volume potentially available for harvest on forestlands suitable for timber production during a specified time period, usually a decade. Although it is a decadal limit, it is most often presented as an average annual volume amount for each alternative. This volume is not a guaranteed harvest volume. Allowable sale quantity is the maximum amount of volume potentially available from suitable timber production lands. The calculation of allowable sale quantity is unconstrained by assumed budget limitations. The actual volume offered would be the aggregate of individual project proposals and would be dependent upon a number of factors, including annual budget and organizational capabilities. Actual volumes offered may also include volumes harvested from lands unsuitable for timber production but available for timber harvest, such as riparian management areas and old forest (see the timber sale program quantity discussion below). The schedule of harvest treatments behind each alternative's allowable sale quantity volume was modeled with the Vegetation Development Dynamics Tool. Multiple model runs were performed for each alternative's allowable sale quantity determination to smooth the random variation of the modeling results.

Timber volume removed from suitable timber production lands is described as "chargeable" volume if it would be applied toward the decadal allowable sale quantity limit. Chargeable volumes include only timber products that meet minimum utilization standards, and are removed from lands suitable for timber production as part of a regular timber production program. Unplanned salvage volumes, fuelwood, and other nonindustrial wood are not considered chargeable volume and are not included in the estimation of the allowable sale quantity.

The estimated harvest schedules behind the allowable sale quantity volumes were not prepared in isolation from the other desired conditions and multiple use objectives of the plan alternatives. The basis for the harvest schedule is the overall design of the alternatives being considered. Analysis of harvest scheduling to determine allowable sale quantity is not limited to being a timber volume optimization exercise, but also considered and evaluated the ability of the harvests to move toward or maintain a set of desired conditions through sustained silvicultural activity over a long time horizon. For example, in addition to providing timber products, these desired conditions and related design elements also include reducing the risk of uncharacteristic fire, reducing insect and disease susceptibility, providing habitat for specific species and controlling the cumulative impact of harvest activity to maintain watershed health. All of these considerations provide reasons for timber harvest activities, and also may impose limitations on the harvest schedule.

Allowable Sale Quantity, Non-declining Flow, and Departures

Under the standard planning rules, the base harvest schedule used to determine the allowable sale quantity for an alternative must not exceed the estimated long-term sustained yield. It also must be formulated on the basis that the quantity of timber planned for sale and harvest for any future decade is equal to or greater than the planned sale and harvest for the preceding decade. This expresses the principle of non-declining flow (or non-declining even flow). The policy of non-declining flow predates the National Forest Management Act, but was enacted into law under the Act in 1976. Scholars studying the historical context of the Act point out that originally the policy was largely concerned with preventing harvest levels from declining in the future, after existing old-growth stands were converted to regulated second-growth stands (Wilkinson and Anderson 1987). The policy recognized that Forest Service harvest programs of the mid-twentieth century, which were focused on bringing old-growth stands under regulated management, were likely to result in an ultimate decline in future timber volumes. The reason for this is that these old stands took centuries to grow, and thus, in effect, “stored” very large volumes of timber on the stump. In future periods, as these stands were only allowed to grow to a commercial rotation age, they would produce less timber volume per acre than their original “conversion” harvest did.

A similar dilemma of sustainability results from the application of the non-declining flow rules within the context of some highly altered contemporary forests. As outlined in the “Forest Vegetation,” “Ecological Resilience,” “Insects and Disease,” and “Wildland Fire” sections of this document, the vast extent of overstocked forest stands currently on the landscape represent a threat to the continued resilience and sustainability of the forest. These areas also now contain many decades worth of “stored” growth and timber volume, and the non-declining flow rules can present an obstacle to their rapid conversion to a lower density, more sustainable condition. This is because, if the pace of thinning harvests was greatly increased within the planning horizon, in the decades immediately thereafter, as harvests are used to maintain low density conditions, rather than create them, these maintenance removals cannot match the timber volumes per acre that were removed during the initial thinning.

The sale schedule of Alternative E-Modified Departure departs from the base harvest schedule principles outlined above, and thus, differs from Alternative E-Modified in that the harvest schedule used to determine the allowable sale quantity was allowed to exceed long-term sustained yield for the first two decades, and did not conform to the non-declining flow requirement. All other plan components are identical to Alternative E-Modified. The forest planning rules compel base harvest schedules to not exceed the long-term sustained yield capacity, and to meet the non-declining flow requirements unless consideration of a deviation, or “departure,” from the base sale schedule is indicated. The National Forest Management Act’s 1982 planning regulations direct National Forests to evaluate alternatives with departure sale schedules if any of the four conditions below are indicated:

1. It is possible to significantly reduce or prevent high mortality losses from any cause; or,
2. It is possible to improve forest age-class distributions; or,
3. Implementation of the base sale schedule would have a substantial adverse impact upon a community in the economic area of the forest; or,
4. It is reasonable to expect that overall multiple-use objectives would otherwise be better attained.

The timely reduction of stand density within overstocked areas of the forest along with related management of the tree species compositions could help prevent high mortality losses from

uncharacteristic wildfire or insect and disease outbreaks. Furthermore, when compared to the existing forest conditions, the desired conditions for forest structural stages point toward a need for significant adjustments to the existing age-class distributions. The current high degree of disparity between the desired conditions for forest vegetation, fire regimes, and insect and disease susceptibility, as compared to the present state of the forests, indicates that the exploration of a departure alternative is warranted. More rapid movement toward the range of desired forest vegetation conditions could potentially support better attainment of overall multiple-use objectives for watershed, outdoor recreation, range, timber, and wildlife.

Alternative E-Modified Departure's allowable sale quantity sale schedule was developed for two decades without the constraint of producing a non-declining flow. Similarly, it was not designed to remain within the long-term sustained yield capacity during that period; however, increased harvest under a departure schedule does not impair the future attainment of the long-term sustained yield capacity. All of the other alternative allowable sale quantity sale schedules were able to demonstrate compliance with the non-declining flow requirement over a 50-year period, and their outputs remain within the calculated long-term sustained yield capacities.

Timber Sale Program Quantity

The timber sale program quantity is the predicted volume of timber planned for sale for each alternative under a full implementation scenario. Expected timber sale program quantity volume is the quantity of timber projected to be sold from lands suitable for timber production, and other lands that would allow timber harvesting to be used as a management tool to achieve other multiple-use objectives. These expected timber sale program quantity levels vary by alternative and are affected by different full implementation budget assumptions. A key difference between timber sale program quantity and the allowable sale quantity volumes is that the timber sale program quantity includes volumes from all lands, whereas the allowable sale quantity is calculated from only those lands suitable for timber production. These lands outside of the land base considered suitable for timber production were considered in calculation of the timber sale program quantity if harvesting was thought to be a useful and compatible tool to control insect or disease susceptibility, to manage fuel loads, to perform experimental harvesting, to improve habitat, or otherwise generally help move the overall forest vegetation closer toward desired conditions.

The schedule of harvest treatments behind each alternative's timber sale program quantity volume was modeled with the Vegetation Development Dynamics Tool. Multiple model runs were performed for each alternative's timber sale program quantity to smooth the random variation of the modeling results. Like the allowable sale quantity modeling, these harvest schedules were not developed solely as timber optimization exercises, but also considered and evaluated the ability of the harvests to move toward or maintain a set of desired conditions over a long time horizon. Multiple iterations were run over a several-decade-long period to ensure a relatively steady flow of timber resulted (except under Alternative E-Modified Departure) while other desired conditions were also being improved or maintained. The general assumption used was that no more than 20 percent of the harvest treatments would occur on lands other than the suitable timber production base. Overall harvesting levels of individual alternatives were scaled up or down in proportion with the assumed implementation budget levels. The final calculation of each alternative's timber sale program quantity harvest schedules represents an annual average treatment level over the next 10 to 15 years paired up with the appropriate timber volume yield tables to produce the total timber volumes.

Timber and Forest Products – Environmental Consequences

Key indicators for timber and forest products include:

- Acres suitable for timber production
- Allowable sale quantity
- Total sale program quantity

Indirect Effects

Lands Suitable for Timber Production for Each Alternative

Timber production suitability was determined for each alternative. Even though Alternative A represents a continuation of current management direction, to compare all of the alternatives fairly, the suitability for Alternative A was updated and recalculated to reflect the past impacts to the 1990 plans by various forest plan amendments and finalization of roadless regulations.

Forestlands remaining after identifying the subset of unsuitable forestlands described above are those that are tentatively available for and capable of timber production. Tentatively suitable forestlands represent the maximum number of acres that could potentially be managed for regular and predictable wood product outputs (like timber production). These acres remained constant as a starting point for the development of alternatives. Tentatively suitable lands were then separated into two categories based on the different design parameters and objectives for each alternative. The lands were identified as:

- Lands suitable for timber production
- Other lands unsuitable for timber production, but available for timber harvest if needed to meet other non-timber, multiple-use desired conditions and objectives

Areas that may have been identified as tentatively suitable, but later identified as unsuited for timber production during the development of some of the alternatives, include riparian management areas, old forest, inventoried roadless areas and other backcountry areas. While inventoried roadless areas are not suitable for timber production and Federal regulations generally prohibit the cutting, sale, or removal of trees within these areas, circumstantial exceptions would allow some limited harvesting options within inventoried roadless areas.

The design of the alternatives further influenced the classification of acres suitable for timber production. Table 301 displays the acres suitable for timber production under each of the alternatives by national forest. Each alternative started with the areas identified as tentatively suitable for timber production. Design parameters for each alternative resulted in a subtraction in acres suitable for timber production from the tentatively suitable acres. The main factors/criteria resulting in a change from suitable to unsuitable included the different alternative approaches with regard to changing classification of the following types of areas to unsuitable: old forest, riparian management areas, MA 3A and 3B (backcountry),MA 1B (preliminary administratively recommended wilderness areas), and specially designated areas (for example, botanical areas, historical areas, or scenic area.). Under most of the alternatives, the objectives of these management areas were not considered compatible with regularly scheduled timber production.

Table 301. Acres suitable for timber production and corresponding percentage of tentatively suitable lands

National Forest	Tentatively Suitable	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. E-Modified	Alt. E-Modified Departure
Malheur	1,245,000	780,000 (63%)	770,000 (62%)	530,000 (43%)	1,080,000 (87%)	770,000 (62%)	770,000 (62%)	779,000 (63%)	779,000 (63%)
Umatilla	817,000	380,000 (47%)	420,000 (51%)	260,000 (32%)	610,000 (75%)	420,000 (51%)	420,000 (51%)	429,000 (53%)	429,000 (53%)
Wallowa-Whitman	1,010,000	590,000 (58%)	530,000 (52%)	310,000 (31%)	770,000 (76%)	530,000 (52%)	530,000 (52%)	558,000 (55%)	558,000 (55%)

Even though Alternative A represents a continuation of current management direction, the area of suitable timber production lands is significantly less than that contained in the 1990s Forest Plans. The suitability for Alternative A was updated and recalculated to reflect the past impacts to the 1990 plans by finalization of the 2001 roadless area regulations and various other forest plan amendments. Alternatives B, E, and F would result in the same number of acres suitable for timber production because these alternatives propose similar plan components and management allocations that influence suitability. Even though the acres of MA 1B (preliminary administratively recommended wilderness areas) and MA 3A and 3B would differ between Alternatives B, E, and F, the difference would not result in a substantial change in suitability because the acres that would be shifted into or out of recommended wilderness areas would remain otherwise classified as unsuitable for timber production. Suitable timber production acres would be approximately 50 to 60 percent of the tentatively suitable lands.

Alternative C would result in the fewest acres suitable for timber production because this alternative would result in a greater number of acres of recommended wilderness and would include wider riparian management areas, both of which would screen out as unsuitable for timber production. Alternative C would also retain all of the designated old forest management areas from Alternative A, and these areas, along with other old forest stands, would not be considered suitable for timber production under Alternative C. Additional areas identified as wildlife corridor management areas in Alternative C would also be unsuitable for timber production. Under Alternative C, lands suitable for timber production would represent approximately 30 percent of the tentatively suitable landbase within the Umatilla and Wallowa-Whitman National Forests, and over 40 percent within the Malheur National Forest.

Alternative D would result in the highest number of acres suitable for timber production within all three National Forests. Under Alternative D, riparian management areas would be narrower than any of the other alternatives. Designated old forest management areas would not be used, nor would old forest stands be screened out of the tentatively suitable base. Alternative D would result in approximately 75 percent of the tentatively suitable base within the Umatilla and Wallowa-Whitman National Forests being considered suitable for timber production, while the Malheur National Forest would designate 87 percent of the tentatively suitable base as timber production lands.

Alternative E-Modified and Alternative E-Modified Departure would use the same amount of suitable timber production lands. These levels represent a minor increase from the original Alternative E across all three National Forests. The main difference in the approach with Alternative E-Modified involved dropping the MA 3C Wildlife Corridors and reclassifying some isolated fragments of MA 3A and 3B. Both of these changes resulted in some areas changing to MA 4A allocation, which allowed those areas to remain within the suitable timber production base.

Long-term Sustained Yield

Table 302, Table 303, and Table 304 display the long-term sustained yield capacity by alternative for each national forest. Differences between the alternatives are largely the result of the differences in the underlying base of lands designated as suitable for timber production. The long-term sustained yield values for Alternative A are based on the suitable timber production acres as recalculated after consideration of the amendments to the original 1990 Forest Plans that have occurred during the previous planning period. Alternative D would result in the highest long-term sustained yield across all three National Forests. With its relatively small allocation of lands suitable for timber production, Alternative C would have the lowest expected long-term sustained yield from these lands across all three National Forests.

As shown in the tables, Alternatives B, E, and F would result in the same level of long-term sustained yield within each national forest. This is because these alternatives have the same number of acres suitable for timber production. Alternatives E-Modified and E-Modified Departure would have a long-term sustained yield capacity slightly higher than the original Alternative E, since E-Modified's suitable timber production lands were increased modestly over the original Alternative E.

Allowable Sale Quantity

Table 302, Table 303, and Table 304 display the allowable sale quantity by alternative for each national forest and compare those values to the long-term sustained yield. Under all of the alternatives, allowable sale quantity would be significantly lower than the allowable sale quantity levels included in the 1990 Forest Plans. This is largely the result of the recalculation of the suitable timber production land as discussed above. General changes in management objectives along with updated inventory data, have all contributed to suitable timber production acres and associated allowable sale quantity levels being decreased under all of the plan revision alternatives as compared to the levels in the original 1990 Forest Plans.

Table 302. Malheur National Forest average annual allowable sale quantity (ASQ), and long-term sustained yield capacity (LTSYC) in million board feet per year

Type of Volume	1990 Forest Plan	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. E-Modified	Alt. E-Modified Departure
ASQ	234	59	75	40	128	75	75	80	112
LTSYC	234-plus	112	106	77	157	106	106	111	111

Table 303. Umatilla National Forest average annual allowable sale quantity (ASQ), and long-term sustained yield capacity (LTSYC) in million board feet per year

Type of Volume	1990 Forest Plan	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. E-Modified	Alt. E-Modified Departure
ASQ	124	34	48	24	90	48	48	53	86
LTSYC	184	56	58	37	90	58	58	61	61

Table 304. Wallowa-Whitman National Forest average annual allowable sale quantity (ASQ), and long-term sustained yield capacity (LTSYC) in million board feet per year

Type of Volume	1990 Forest Plan	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. E-Modified	Alt. E-Modified Departure
ASQ	141	50	57	25	92	57	57	64	85
LTSYC	215	76	74	41	107	74	74	77	77

With the exception of the departure version of Alternative E-Modified, all of the allowable sale quantity levels were developed from harvest schedules designed to not exceed long-term sustained yield and comply with non-declining flow principles. The allowable sale quantities of the departure alternative would be expected to exceed the estimated long-term sustained yield for the next planning period.

Alternative D would result in the highest allowable sale quantity across all three National Forests, which, in turn, would allow the highest potential volume of timber harvesting from suitable production lands. The departure version of Alternative E-Modified would allow the next highest allowable sale quantity level, but because the base of land suitable for timber production is significantly smaller than Alternative D, this level of allowable sale quantity would exceed the estimated long-term sustained yield. The base version of Alternative E-Modified conforms to the non-declining flow rules, remains within the limits of the long-term sustained yield, and results in the third highest allowable sale quantity for all three National Forests.

On the other end of the spectrum, Alternative C would have the lowest allowable sale quantity across all three National Forests. Under Alternative C, the allowable sale quantity would allow an average annual volume of about 24 to 25 million board feet to be harvested annually from suitable lands from the Wallowa-Whitman and Umatilla National Forests, and up to an average annual volume of about 40 million board feet per year from the Malheur’s suitable base.

Timber Sale Program Quantity

Table 305, Table 306, and Table 307 show that under full implementation, Alternative D would result in the highest timber sale program quantity across all three National Forests. For the Malheur, the projected volume sold from the suitable timber production lands would represent about 93 percent of the alternative’s allowable sale quantity limit. The Wallowa-Whitman would sell around 96 percent of its allowable sale quantity limit and the Umatilla would sell at its allowable sale quantity limit under Alternative D. The high timber sale program quantity volume levels associated with Alternative D were modeled under a sustainable non-declining flow scenario, but reflect the utilization of a significantly larger base of lands considered suitable for timber harvesting.

The second highest timber sale program quantity volumes would be associated with Alternative E-Modified Departure. If fully implemented, the accelerated harvesting associated with this alternative would produce approximately 94 and 98 million board feet a year from the Umatilla and Wallowa-Whitman National Forests respectively. The Malheur’s departure alternative objective would be over 130 million board feet annually. Both of these high output alternatives would represent increases in output of 3 to 5 times what is projected under Alternative A’s no-action scenario. Alternatives D, E, E-Modified, and E-Modified Departure would presumably require large increases in timber program budgets and workforce capacity in order to reach these full implementation levels.

Table 305. Timber sale program quantity (TSPQ) by alternative for the Malheur National Forest (million board feet per year)

Malheur	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. E-Modified	Alt. E-Modified Departure
Volume from suitable timber production lands	29	36	14	119	64	44	62	112
Volume from other forest lands	3	9	2	22	19	14	22	22
Total TSPQ	**32**	**45**	**16**	**141**	**83**	**58**	**84**	**134**

Table 306. Timber sale program quantity (TSPQ) by alternative for the Umatilla National Forest (million board feet per year)

Umatilla	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. E-Modified	Alt. E-Modified Departure
Volume from suitable timber production lands	24	31	11	90	47	39	47	86
Volume from other forest lands	3	6	3	18	10	8	9	8
Total TSPQ	**27**	**37**	**14**	**108**	**57**	**47**	**56**	**94**

Table 307. Timber sale program quantity (TSPQ) by alternative for the Wallowa-Whitman National Forest (million board feet per year)

Wallowa-Whitman	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. E-Modified	Alt. E-Modified Departure
Volume from suitable timber production lands	18	25	9	88	52	34	52	85
Volume from other forest lands	2	5	2	16	11	7	13	13
Total TSPQ	**20**	**30**	**11**	**104**	**63**	**41**	**65**	**98**

Compared to the no-action alternative (Alternative A), Alternatives E and E-Modified would also represent significant increases in timber volume sold across all three National Forests. The timber sale program quantity of both Alternatives E-Modified and E-Modified Departure were based on a harvest schedule that placed particular emphasis on the most critical forest restoration needs. Alternative E-Modified Departure was specifically designed to thin most all of the uncharacteristically dense dry upland forest within a 20-year timeframe. Unconstrained by the non-declining flow requirements, this alternative could make the most progress toward removing the backlog of growth from the suitable timber production lands over the next planning horizon.

On the other hand, once this backlog of thinning on the suitable timber production base is addressed, the out-year modeling showed timber sale program quantity volumes dropping by over 50 percent as the timber program shifted away from the initial thinning of stands containing high volumes per acre. These abnormally dense areas of dry upland forest now contain many decades worth of “stored” growth and timber volume. After the harvest schedule of the departure alternative completes its accelerated schedule of harvesting in the first two decades; in subsequent

decades, as harvests are used primarily to maintain low density conditions, these removals cannot match the timber volumes per acre that were removed during the initial thinning harvests.

At the other end of the range, the timber sale program quantity objectives of Alternative C would mean reductions in timber outputs of 50 percent or more for each of the National Forests compared to current levels as predicted by the no-action alternative. These objective levels would not likely be high enough to match the net annual growth occurring within the suitable timber production lands.

Salvage Harvest Effects

The Forest Service definition of salvage harvesting is the removal of dead trees or trees being damaged or dying due to injurious agents other than competition, to recover value that would otherwise be lost. As the name implies, the main point of salvage harvesting is to utilize the dead or dying trees with the idea of minimizing financial losses. The social value of economic and other potential resource benefits of salvage harvesting versus potential harmful changes to habitats or soil resource conditions has been debated in scientific and policy forums for decades. The ecological concerns raised about salvage harvesting typically involve potential effects to soils, terrestrial wildlife, riparian systems, and aquatic ecology (Peterson et al. 2009). The potential effects to these resource areas are discussed within other sections of this document. Salvage harvesting is also discussed in the context of ecological resilience within the “Ecological Resilience” section in volume 1.

The practice of salvage harvesting has been conducted for many decades in the National Forests of the Blue Mountains, and the practice is allowed under various different constraints across alternatives. Several standards and/or guidelines were included in the different alternatives with the intent of protecting the wildlife habitat values of snags and post-fire forest conditions. The most substantial and restrictive direction affecting salvage harvesting is included as part of Alternatives B, C, E and F. All four of these alternatives contain a standard that prohibits salvage treatments from removing any snags (standing dead trees) over 21-inches diameter from within dry upland or moist upland forests. Additionally, this standard would require salvage harvests to retain at least 50 percent of the snags ranging in size from 12 to 21 inches in diameter. In addition to this standard, Alternatives B, E and F contain restrictions on salvaging specific to post-fire conditions. In addition to the previous restrictions, these standards and guidelines will restrict salvage harvest from occurring in at least half of all burned areas, and they will prohibit salvage logging within burns of less than 100 acres. The combined effects of these standards and guidelines would be to significantly limit the amount of potential salvage harvesting under these alternatives.

Alternative D contains none of these specific restrictions, so the appropriate level of salvage harvesting would be based on whether the specific proposals were determined to be consistent with other plan components. Alternative E-Modified contains none of the above mentioned standards or guidelines either, but would include guidelines requiring the level of proposed salvage harvesting to be consistent with specific and measurable desired conditions for snag retention and post-fire habitat. In the case of Alternative E-Modified, the extent and intensity of future salvage harvesting could be scaled up if the underlying disturbance events have been shown to be uncharacteristically large or severe, and salvaging would be constrained during periods, or within areas where tree mortality events have been uncommon.

The window for recovering the value and merchantable timber volume of trees after they have died is often only a few years, as the trees tend to rapidly deteriorate from checking, fungal decay

and staining as well as wood boring insects (Lowell et. al. 1992). Despite these limits, the existence of substantial salvable timber in high-mortality locations is often included in Forest Service timber programs because of the opportunities to enhance jobs and income opportunities in the local communities that are impacted by events like severe wildfire or insect epidemics. However, the actual effect of timber salvaging operations on the overall national forest timber program outputs may also depend on whether the salvage volume represents an overall increase in output, or is just a substitute for other “green” timber volume that would have otherwise been offered.

Another potential side effect of large scale salvage harvesting as part of the timber program is that, in the context of the local market, the sudden influx of products at the mills can tend to depress prices, thereby affecting the decisions and welfare of private and other timber owners. However, even accounting for the negative market effects that significant salvage volume would have on prices, Prestemon (2013) showed that northwestern states including Oregon and Washington, could potentially generate positive net revenues on National Forest lands, across a wide range of potential salvage intensities.

Cumulative Effects

Potential cumulative effects were analyzed by considering the effects of the alternatives in the context of past, present (ongoing), and reasonably foreseeable future activities that have or may likely occur within the vegetation cumulative effects analysis area. This analysis area consists of the 25 subbasins (HUC 4) which contain the Malheur, Umatilla, and Wallowa-Whitman National Forests and other lands. The time period into the future considered was 50 years. The effects that past activities have had on the existing timber resources are reflected in the “Forest Vegetation” existing conditions. Present and foreseeable future activities that could affect forest vegetation are summarized below.

The ability of the National Forests within the Blue Mountains to constructively manage forest vegetation is partially dependent on the ability to use timber harvesting as a management tool. The continued existence of this too depends in part upon the ability to sell forest products to manufacturing companies and other private sector partners. If the forest products industry continues to decline in areas surrounding the Blue Mountains to the extent that it is more difficult to sell forest products, or if stumpage prices decrease substantially, it would negatively affect the amount of timber volume that could be feasibly sold during the planning period. If markets improve and demand for forest products increases, there will be the desire and support for more timber from the National Forests.

The vast majority of the forestland within the Plan Area is federally managed by one of the three National Forests. Most of the other forestland within and adjacent to the National Forests is either owned by private individuals or forest products companies, with a small amount being managed by tribal governments or other federal agencies like the Bureau of Land Management. Timber harvesting and many other related silvicultural treatments on forestlands of other ownership are controlled by State forest practices statutes, as well as a number of State and Federal regulations and incentives designed to protect the productivity and environmental quality of natural resources. The Forest Service does not have the authority to regulate any activities or their timing on lands other than those they administer.

Management objectives on these largely privately owned forestlands tend to focus on fuel reduction and timber production. Actions or the lack of actions that may take place under the various alternatives on National Forest System lands may cause direct, indirect or cumulative

effects on adjacent lands of other ownership. If harvesting programs of the three National Forests ramp up significantly, there could be a resulting decrease in stumpage prices or demand for privately owned timber resources in the area. Similarly, if Forest Service harvesting is curtailed over the planning horizon, the demand for privately owned timber and related harvesting would likely increase to some extent. Land uses, subdivision, and development of privately owned forestland within the adjacent forestlands is expected to continue to occur only at modest rates and is not anticipated to result in any significant curtailment of the availability of timber from other sources to local industry.

As related in the discussion above, past timber harvesting and removals have for the most part, not kept pace with net rate of growth of timber throughout the Blue Mountains national forests. The abundance of relatively small-scale implementation projects has contributed to a growing backlog of excess timber growth. One notable exception to this pattern has been the award of a large-scale 10-year Integrated Resource Service Contract by the Malheur National Forest in 2013. This 10-year contractual obligation to supply substantial volumes of timber has been underway for several years now. It has provided, and will continue to provide additional momentum to the planning and implementation of timber harvesting projects by the Malheur National Forest for at least the remaining term of the contract. The annual timber volume sold target for the Malheur National Forest has increased from 29 million board feet in 2012, to a target program of approximately 75 million board feet per year currently. As the service contract work expands through subsequent annual task orders, a level of certainty is likely to continue to develop for local contractors, encouraging their investment in the infrastructure necessary to fully accomplish needed restoration work across the Malheur and other eastside Oregon national forests.

The greatest amount of foreseeable actions connected to the future timber and forest products outputs of the three National Forests is related to the ongoing Eastside Restoration Strategy. This effort, supported by the Pacific Northwest Regional Office of the Forest Service, started in 2013 as a way of putting resources and a focus on some different methods of planning and implementing forest restoration projects on the eastside National Forests of Oregon and Washington. Since 2013, the effort has supported the development of five Collaborative Forest Landscape Restoration projects and five Joint Chief's projects, which combine the forces of the Forest Service and the Natural Resources Conservation Service to restore forests and reduce fuel loadings across adjoining Federal and non-Federal lands in priority areas. The Blue Mountains Restoration Team has recently completed the Lower Joseph Creek Restoration Project Final Environmental Impact Statement and the Record of Decision for that implementation project was finalized in March of 2017. The same team is currently working on the landscape scale Blue Mountains Forest Resiliency Project, which encompasses parts of four National Forests in the Blue Mountains of Oregon and may cover up to 610,000 acres of thinning and prescribed fire treatments, including substantial acreages of commercial harvest of forest products. All of these planning efforts will tend to support the future implementation of the revised Forest Plans.

Insects and Diseases

Natural disturbances (including wildfire, insects, diseases, and weather events) play a fundamental role in shaping ecosystems and in creating patterns of vegetation at multiple scales. Wildfire is generally viewed as having the greatest potential to impact the Blue Mountains national forests, but in actuality forest insects and diseases are the most pervasive and important agents of disturbance in North American forests, affecting an area almost 50 times larger than fire and with an economic impact nearly five times as great (Logan et al. 2003). This section discusses the roles and impacts of tree-dependent insects and diseases on the health of the Blue

Mountains national forests. It examines the risk of tree loss caused by insects and diseases resulting from current conditions and estimates what insect and disease susceptibility would be if forest vegetation conditions were similar to the historical range of variability. The effects of forest management activities or lack of management activities as implemented by the alternatives is discussed.

Changes Made Between the Draft and Final Environmental Impact Statements

Aside from the global changes throughout this environmental impact statement described in the Preface to this document (see Volume 1), the following changes were made specifically to this section:

Additional background and context information provided pertaining to the insect and disease affected environment: In reviewing public comments related to insect and disease issues in general, it was apparent that providing additional information and improving the clarity of this section would help readers and stakeholders understand the definitions, ideas and context surrounding these processes. Additional discussion was added to the “Affected Environment” section to more clearly explain some of the analysis methodology used and to provide additional context.

Insects and Diseases – Affected Environment

Forest health is an ambiguous concept, one that is not well defined scientifically. People have wide-ranging views on what constitutes a healthy forest, but most would agree that a healthy forest is not expected to be completely free of damaging insects, diseases or other disturbances. However, many definitions of forest health do include the ideas that a healthy forest maintains its ecological function, diversity and resiliency, and a healthy forest also provides for human needs and is not visually dominated by mortality. A healthy forest is one that can meet economic, social and ecological functions both now and in the future. The healthy forest concept directs forest management to focus more on the forest condition and underlying causes of insect or disease issues. Consequently, outbreaks of insect and disease agents are viewed as a symptom of an unhealthy forest condition, rather than the “problem” itself (Ciesla 2011).

Beginning in the early 1900s, forest insects and diseases were traditionally considered pests, and control was aimed at reducing their effects on host trees, or at reducing population numbers as low as possible (Scott and Schmitt 1996). This philosophy is still applied to nonnative insects and diseases, such as the balsam woolly adelgid (*Adelges piceae*) and white pine blister rust (*Cronartium ribicola*), which were inadvertently introduced into the United States from other continents, but native insects and diseases are recognized as natural disturbance agents. All native insects and diseases play a natural role in the ecosystem within which they evolved. Interactions can be very complex between different insect and disease agents and their host tree species, the surrounding environment, and each other. Some level of activity by these agents is always expected, although the extent and severity of damage can vary in terms of how much area is affected and how often effects occur.

When forest conditions are within their historical range of variability, native insects and diseases are nearly always present, often remain at low levels, and are of little concern. Such low numbers are referred to as “endemic” populations. In these circumstances, they are generally not considered pests because they act as natural thinning agents, killing individual trees or small to large tree groups. Contemporary thinking in terms of overall forest health and ecosystem

management now recognizes the importance of an endemic level of insects and diseases consistent with historical levels of activity within the natural range of variability. Insects and diseases play a natural role in the ecosystem. They play a critical role in terms of both terrestrial and aquatic habitats and also nutrient cycling. They create snags and down logs needed as habitat. Trees with decay and witches' brooms also provide habitat for a variety of forest-dwelling flora and fauna including microbes, fungi, invertebrates, small animals, and cavity-nesting birds.

From time to time, significant outbreaks cause rapid changes across the forest. For example, bark beetles can build to high populations relatively quickly and can cause widespread tree mortality, significantly altering forest conditions. Diseases are more likely to increase gradually or remain at similar levels over time, depending on forest conditions. Dwarf mistletoes and root diseases are ever-present in the forest and are some of the main contributors to growth loss, reduced vigor and mortality in their hosts. Insects and diseases often interact, such as when root diseases predispose trees to bark beetle attack (USDA Forest Service 2010e).

At times, natural or human-caused events or conditions can cause insects and diseases to increase or become more prevalent. This can occur from the high-elevation subalpine forests to the urban forests that line the streets of our cities and towns. Fire, wind, and drought can weaken host trees and create favorable environments for insects and diseases to attack. Altered age, density, species composition, and structural stages can also lead to greater susceptibility and increased disease and insect activity. For example, widespread and mostly human caused changes throughout large areas of the Blue Mountains national forests, particularly within the dry and moist mixed conifer types, have helped to create conditions now dominated by areas of dense, multi-layered shade-tolerant grand fir that are more susceptible to many common insect and disease agents (Stine et al. 2014). Similar circumstances have been noted throughout the interior west, as a century of fire protection has produced a steady shift away from open ponderosa pine and western larch forests toward denser fir forests. Past harvesting of high-value overstories of larch and ponderosa pine has also accelerated this conversion to dense insect and pathogen susceptible forests (Parker et al. 2006). The dramatic increase in the abundance of grand fir in particular has been noted within this region for over twenty years, and this species is particularly susceptible to root pathogens, bark beetles, defoliators, and dwarf mistletoe (Hessburg et al. 1994).

There is a multitude of different insect and disease agents currently present and active throughout the Blue Mountains area. The following representative major insect and disease agents are highlighted in terms of potential impacts and susceptibility factors. All of these agents or groups are considered to be among some of the most common and influential insect and disease pests of eastern Oregon and southeastern Washington conifers (Shaw et al. 2009). Some of these agents are presently producing noticeable impacts within the Blue Mountains national forests, and all have a significant potential to produce severe levels of damage based on the highly susceptible stand structures and species compositions that are now characteristic of the existing forest vegetation condition.

Table 308. Some major native insect and disease agents of Blue Mountains conifers

Insect or Disease Agent	Major Local Host Species
Defoliators; such as western spruce budworm (*Choristoneura freemani*); Douglas-fir tussock moth (*Orgyia pseudotsugata)*	Douglas-fir, grand fir, subalpine fir
Douglas-fir beetles *(Dendroctonus pseudotsugae)*	Douglas-fir
Fir engraver *(Scolytus ventralis)*	Grand fir, subalpine fir
Spruce beetle (*Dendroctonus rufipennis*)	Engelmann spruce
Bark beetles in ponderosa pine; such as western pine beetle *(Dendroctonus brevicomis)*; mountain pine beetle *(Dendroctonus ponderosae)*	Ponderosa pine
Mountain pine beetle in lodgepole pine	Lodgepole pine
Douglas-fir dwarf mistletoe (*Arceuthobium douglasii*)	Douglas-fir
Western larch dwarf mistletoe (*Arceuthobium laricis)*	Western larch
Root diseases; such as Armillaria (*Armillaria ostoyae*); Laminated root rot (*Phellinus sulphurascens*), and Annosus (*Heterobasidion* annosum)	Douglas-fir, grand fir, subalpine fir, Engelmann spruce, pine species

Bark Beetles

Numerous bark beetle species exist across the Blue Mountains national forests. Almost all native conifers, as well as some deciduous trees, can be attacked to some degree, by bark beetles. Some of the most significant species are mountain pine beetle, western pine beetle, spruce beetle, fir engraver and Douglas-fir beetle. Complex interactions between wildfire, insects, diseases, and landscape pattern play major roles in determining the susceptibility of forest lands to bark beetle damage (Parker et al. 2006; Stine et al. 2014; Hessburg et al. 2016). Beetle populations and corresponding tree mortality generally increase in conjunction with one or more of the following conditions: drought, overstocked tree densities, preponderance of host species, simplified homogenous landscape patterns, stress caused by other damage agents like root decay fungi or defoliating insects, and buildup of fresh, dead, down wood as brood material across large areas.

For example, Waring and Pitman (1985) observed that trees with low vigor were more heavily attacked by mountain pine beetle and some produced no defensive resin. Safranyik and Wilson (2006) also found host susceptibility to mountain pine beetle attack may be affected by the age, species composition, and continuity of mature forest stands. Other scientists have observed that lodgepole pine trees in particular are more susceptible as they become older (80 years) and larger than 8 inches diameter (Gibson et al. 2009).

Douglas-fir beetle, under typical conditions, prefers to attack trees that are weakened by fire scorch, defoliation, windthrow or root disease. Where such stressed and susceptible Douglas-fir trees become abundant, populations can build up rapidly and spread to adjacent healthy trees. Drought, which also lowers tree resistance, appears to help sustain outbreaks and may play a role in initiating outbreaks in some areas. Furniss and Kegley (2014) found that stands most susceptible to Douglas-fir beetle are generally mature or older, have a majority of Douglas-fir species and are exhibiting above average density.

Research suggests the fir engraver rarely attacks healthy trees, but generally are attracted to trees of low-vigor resulting from a variety of conditions including overstocking, root disease, defoliation, lightning strikes and drought (Goheen and Hanson 1993; Hessburg, et al. 1994). Epidemics of fir engraver are observed most frequently in the Pacific Northwest and California and are often associated with periods of drought. Trees infected with root disease or defoliated by

Douglas-fir tussock moth or western spruce budworm are also especially predisposed to attack (USDA Forest Service 2010e; Goheen and Willhite 2006). One of the favorite hosts of fir engraver, grand fir, has previously never occurred in such abundance (Hessburg et al. 1994; Stine et al. 2014). This species shift in the Blue Mountains in the last century away from ponderosa pine and western larch and towards more shade-tolerant trees like grand fir, has created hundreds of thousands of acres of fir trees, many under stress from overstocking, currently contributing to very favorable habitat conditions for fir engraver beetles.

Defoliators

The western spruce budworm is probably the most widely distributed and destructive defoliator of coniferous forests in western North America and the Douglas-fir tussock moth is also a major defoliator with a history of large outbreaks in the Blue Mountains region. Despite the common names western "spruce" budworm and "Douglas-fir" tussock moth, the most preferred host species for these defoliators in western North America are grand fir, subalpine fir and Douglas-fir. Attacks by the larvae of these insects can cause topkill, reduced growth/vigor or death of the host. A single defoliation event does not usually cause tree mortality; however, continued attacks or severe abiotic factors, such as weather and drought, combined with continued attacks can cause mortality. Trees severely defoliated by these agents may become predisposed to one or more species of tree-killing bark beetles (Goheen and Willhite 2006; USDA Forest Service 2010e). A preponderance of host species and low tree vigor due to high tree densities are some of the major predisposing factors contributing to vulnerability. Reduction in moisture availability has also been suggested as an important driver of western spruce budworm outbreaks (Campbell 1993). Additionally, dense, multi-layered forest structure makes stands especially vulnerable to defoliator outbreaks, as this structure aids larva survival by improving its ability to disperse downwards through the canopy layers while avoiding predators (Brookes et al. 1987; Parker et al. 2006; Maclauchlan and Brooks 2009).

Root Disease

Forest root diseases like laminated root rot and Armillaria root disease are among the most difficult disease agents to identify, quantify and manage. Most western conifers are vulnerable to one or more of these root diseases, but susceptibility varies greatly among species. Grand fir and interior Douglas-fir are highly susceptible to these species of root pathogens (Filip and Schmitt 1990). As parasites, these fungi cause wood decay, reduced growth, windthrow and outright mortality. These fungi can infect healthy trees, but individuals that have already been stressed or weakened by other factors can be predisposed to root disease (Wargo and Harrington 1991; Filip and Schmitt 1990). Drought has been indirectly associated with conditions favorable for development of root disease, by increasing the stress of host trees (Kolb et al. 2016). Similarly, frequently bark beetles, including fir engraver, are associated with attacking trees that are suffering from root disease.

Dwarf Mistletoe

Dwarf mistletoes are parasitic plants of conifers that obtain almost all of their needs, including water, minerals, and nutrients, from their hosts. Fulfilling these resource requirements stresses infected trees, causing reductions in growth, cone and seed production and, with high enough infection levels, mortality. Tree growth and vigor usually decline when more than half of the crown is parasitized. Most trees survive infection for decades, but small trees tend to decline and die more quickly than large ones (USDA Forest Service 2010e). Increased mortality among dwarf mistletoe infected trees has been observed in stands of high density and during droughts. Parasitic

plants tend to intensify the negative impacts of drought on tree water stress, and tree mortality in areas with extensive infection is often three to four times higher than in uninfected areas (Kolb et al. 2016).

Landscape Pattern Influences

The vulnerability to negative impacts from all of these insect and disease agents is also being exacerbated by the changes that have occurred to the distribution and patterns of forest vegetation across the landscape. Forest landscapes that have been simplified and made uniform by either large-scale disturbances or past management practices can amplify the spread of future disturbances (Parker et al. 2006; Hessburg et al. 2016). Conversely, landscapes that are diversified tend to dampen the buildup and spread of large-scale outbreaks (Seidl et al. 2016). Hemstrom (2001) observed that generally, forests that are older, composed of larger trees, denser, more uniform, or contiguous than would be expected under natural or historical disturbance regimes are going to be more vulnerable to mortality from insect and disease. Historically, highly susceptible stands of host species were discontinuous and stands of less vulnerable species were common on most landscapes. This natural pattern of vegetation localized the extent and duration of many insect and disease outbreaks, mostly by limiting available or suitable habitat. Currently, with an increasing abundance of susceptible fir dominated stands positioned close to each other, insect and disease agents can readily disperse from stand to stand across landscapes (Hessburg et al. 1994). Many scientists now recognize that large areas of the dry upland forests and mixed conifer forests observed in modern-day landscapes have been over-simplified and currently exist in highly altered patterns characterized by unusually large expanses of dense, uniform forests dominated by vulnerable shade-tolerant species like grand fir (Parker et al. 2006; Stine et al. 2014; Hessburg et al. 2015; Hessburg et al. 2016). The susceptibility to outbreaks is likely currently elevated in many areas of the Blue Mountains where considerably fewer host trees were growing 100 years ago.

Climate Change Influences

Climate is another factor influencing insect and disease disturbance regimes and the incidence of large disturbance events. Climate influences the geographic distribution, population dynamics, and disturbance effects of insects and diseases through either direct environmental impacts on the development and survival of insect and disease organisms, or by altering host susceptibility and defense capabilities (Peterson et al. 2014). For example, winter temperatures can affect survival of insects in temperate zones, while spring/summer temperatures influence insect life cycles.

Insect life cycles depend on a complex interaction of temperature, moisture, and suitable hosts. Although outbreak dynamics differ from species to species and from forest to forest, climate change appears to be one driving factor for some of the current forest insect outbreaks in western North America (Logan et al. 2003; Bentz et al. 2010; Kolb et al. 2016). Warming temperatures could increase the potential for insect and disease outbreaks, particularly in areas where insect or pathogen activity has been limited by suboptimal temperatures. Warming temperatures can also be detrimental to insects, for instance eliminating the prolonged cold period or “cold diapause” some insects require to complete development. Temperature influences everything in an insect’s life, from the number of eggs laid by a single female, to the insects’ ability to disperse to new hosts, to over-winter survival, and developmental timing. Elevated temperatures associated with climate change, particularly when there are consecutive warm years, may benefit insects currently not viewed as pests and some of our longtime pests may become less important. For many forest insect species of current concern (primarily bark beetles), the influence of elevated temperatures

on outbreak dynamics is most notable at higher elevations and latitudes where some beetles have shifted to completing their development in a single year, rather than two or even three years. All else remaining constant, this decrease in generation time translates to an increasing rate of population growth. Because of effects like these, geographic distributions of insect and diseases have changed in the past in response to climate change, and shifts in the north/south range distribution or into higher elevations are likely (Bentz et al. 2010).

Climate also influences insect and disease impacts indirectly by modifying vigor and defenses in host plants (Bentz et al. 2010; Raffa et al. 2008). Climatic variability can alter stress levels and affect the susceptibility of trees to insect attacks and plant diseases. The more extreme weather fluctuations predicted by many climate models will have unpredictable effects on insects, diseases, and their host plants. Tree mortality in response to heat and drought stress is often facilitated by insects and diseases; trees weakened by prolonged drought stress have reduced defenses against the insect and disease attacks that eventually kill the tree (Kolb et al. 2016). For example, extensive, rapid, mortality of aspen in western Colorado during drought conditions was attributed to insects and diseases that normally would have had limited impacts if drought had not weakened and predisposed the trees to mortality (Worrall et al. 2010, 2013).

Insects and Diseases – Existing Conditions

Although disturbances such as those caused by native insects and diseases can contribute to natural dynamics of forest health, exceptional droughts in combination with other factors, are pushing some forests beyond thresholds of sustainability. Uncharacteristically large insect outbreaks have become more common in many western forests and are resulting in forest mortality beyond the levels of 20th-century experience (Raffa et al. 2008; Millar and Stephenson 2015). For example, since 1990, native bark beetles have killed billions of trees across millions of acres of forest from Alaska to northern Mexico. Although bark beetle infestations are a regular force of natural change in forested ecosystems, several of the current outbreaks, which are occurring simultaneously across western North America, are the largest and most severe in recorded history (Bentz et al. 2009). Forest insects and pathogens are the most pervasive and important agents of disturbance in North American forests, affecting an area almost 50 times larger than fire and with an economic impact nearly five times as great (Logan et al. 2003).

Outbreak and epidemic dynamics vary between damage agents and from forest to forest, but the combination of a few major factors appears to be driving most of the current outbreaks. These major factors are changing climatic conditions, in particular elevated temperatures and drought combined with an abundance of uncharacteristically dense concentrations of highly susceptible tree species. To evaluate the Blue Mountains national forests' susceptibility and vulnerability to insects and diseases, a risk assessment was conducted in 2009 specifically for the Malheur, Umatilla, and Wallowa-Whitman National Forests using forest conditions as depicted by the Continuous Vegetation Survey (CVS) forest plot data. Details of the assessment's methods are available in the project record, but the basic approach followed the procedures outlined by Schmitt and Powell's (2005) *"Rating Forest Stands for Insect and Disease Susceptibility."* A variety of forest stand parameters and factors, such as ecoclass, stand density, host density, stand composition and structure, and observations for insect and disease activity were used to rate susceptibility of forest tree species to the15 most damaging insect and disease agents in the Blue Mountains. The predicted percent mortality levels from each insect or disease agent or interaction of agents and susceptible tree species combination was applied against the actual volume of that tree species occurring on each plot. With CVS data and FVS (Forest Vegetation Simulator) the

total predicted 15-year volume loss for each species was aggregated for each plot and then converted to a percent of the total volume occurring on the plot. These results were summarized by upland forest potential vegetation group, by National Forest, and by structural stages. This risk assessment estimates the level of tree mortality likely to occur over the next 15 years.

Table 309 displays the percent of continuous vegetation survey plots, and by inference, the percent of the forest areas that currently exist within each predicted mortality category (Countryman and Justice 2009). The analysis is for the Malheur, Umatilla, and Wallowa-Whitman National Forests combined. Predicted mortality is described as a percentage of loss anticipated over a subsequent 15-year period. Taken as a whole, the dry upland forest potential vegetation group exhibits the highest current insect and disease risk hazard, compared to the other upland forest potential vegetation groups. Within the dry upland forest potential vegetation group, approximately 18 percent of the plots are in the 50 percent plus predicted mortality category and 23 percent of the plots are in the 25 to 50 percent predicted mortality category. In other words, modeling indicates that over 40 percent of the dry upland forest potential vegetation group may lose from one quarter to over one-half of its live forest to insect and disease-related mortality over the next 15 years. These results are in line with the fact that the dry upland forest potential vegetation group exhibits the greatest amount of departure from historical forest vegetation conditions in terms of stand structure, density, and species composition (see “Ecological Resilience” and “Forest Vegetation” sections of Chapter 3). Increased tree densities resulting from fire exclusion and suppression, combined with the absence of effective density management have resulted in overstocked stands, increased competition between trees for moisture, nutrients, and sunlight, decreased tree health, growth, and vigor, altered stand structural stages, and an increased proportion of more susceptible tree species. These are all factors that are contributing to the current high levels of risk hazard in the dry upland forest.

Table 309. Percent of continuous vegetation survey (CVS) plots within predicted mortality categories (percentage of mortality loss) by upland forest potential vegetation group (for the Malheur, Umatilla, and Wallowa-Whitman National Forests combined)

Predicted Mortality by Potential Vegetation Group	0-5%	5-15%	15-25%	25-50%	50% Plus
Cold upland forest (percent of CVS plots)	32%	40%	18%	8%	2%
Moist upland forest (percent of CVS plots)	16%	33%	34%	17%	1%
Dry upland forest percent of CVS plots)	17%	24%	18%	23%	18%

Within the moist upland forest potential vegetation group, only about 1 percent of the plots are in the highest 50 percent plus predicted mortality category, but approximately 17 percent of the plots are in the 25 to 50 percent predicted mortality category. Within the moist upland forest potential vegetation group, the insect and disease risk hazard is not as high as the mortality level predicted for the dry upland forest, yet the risk is substantial. Again, these results are consistent with the moderately high levels of departure from the historical range of variability for the moist upland forest vegetation, particularly in regards to species composition, that are described in detail within the Ecological Resilience and Forest Vegetation sections of Chapter 3.

The cold upland forest potential vegetation group exhibits the lowest insect and disease risk hazard, compared with the other upland forest potential vegetation groups. This is likely related to

the fact that the cold upland forest potential vegetation group tends to exhibit less departure from historical forest conditions in terms of stand structure, density, and species composition.

Table 310 displays the percent of continuous vegetation survey plots, and by inference, the percent of the forest areas that are within each predicted mortality category, summarized by individual National Forest. Predicted mortality is described as a percentage of live forest lost to mortality over a subsequent period of 15 years. The Malheur National Forest exhibits a significantly higher level of insect and disease risk hazard, in comparison with the other two forests. Within the Malheur National Forest, approximately 28 percent of the plots are in the 50 percent plus predicted mortality category. Modeling indicates that almost 30 percent of the Malheur National Forest might lose over half of its live forest to insect and disease related mortality over the next 15 years. This is in addition to the approximately 20 percent in the 25 to 50 percent predicted mortality category. The difference between the Malheur and the other two Forests is likely related to the Malheur National Forest containing a much higher percent of the landscape in the dry upland forest potential vegetation group, and the lowest percent of the landscape in the cold upland forest potential vegetation group.

Table 310. Percent of continuous vegetation survey (CVS) plots within predicted mortality categories (percentage of mortality loss) by national forest

Predicted Mortality by National Forest	0-5%	5-15%	15-25%	25-50%	50% Plus
Malheur (percent of CVS plots)	17%	21%	14%	20%	28%
Umatilla (percent of CVS plots)	20%	30%	29%	20%	2%
Wallowa-Whitman (percent of CVS plots)	21%	35%	24%	19%	2%

Another assessment dealing with the forest health of the Blue Mountains was also completed recently (Jennings 2016). This report was prepared to support an evaluation of the potential to designate insect and disease treatment areas on the Blue Mountains national forests in accordance with Section 602 of the Healthy Forests Restoration Act (2014 Amendment) of 2003. The Jennings (2016) report focused primarily on current trends in bark beetle caused mortality of trees in recent years as well as risk of bark beetle caused tree deaths in the near future. Average mortality caused by these bark beetles from 2012 to 2015 was found to have increased more than 13-fold over the average annual mortality of the previous five years and 11-fold over the previous ten years. The most important bark beetle species observed to be causing the tree mortality were mountain pine beetle, western pine beetle, Douglas-fir beetle and fir engraver. By analyzing data from the "National Insect and Disease Forest Risk Assessment" (Krist et al. 2014), Jennings (2016) also concluded that over an area spanning 2.2 million acres of the Blue Mountains national forests, approximately 13 percent of the current live tree basal area is categorized likely to be killed by bark beetles within the next 11 years. Recently observed levels of tree mortality from 2015-2017 on the Malheur National Forest support this assessment (see ADS data: https://www.fs.usda.gov/detail/r6/forest-grasslandhealth/insects-diseases/?cid=stelprdb5294941).

Recent General Trends

Recent general trends were examined from the Forest Service's Forest Health and Protection report: "Major forest insect and disease conditions in the United States: 2013" (Jenkins 2015).

Aerial surveys are used annually to detect and evaluate forest conditions throughout the nation. This report provides an overview and summary for many of the major agents observed, along with recent trends. On a national level, looking at bark beetles of the west as an overall group, detected mortality has been declining since peaking in 2009. The primary reason for the decline, however, was fewer acres reported with mountain pine beetle mortality because large areas of the mountain west that were previously affected no longer contain suitable host trees. However, within Oregon specifically, mountain pine beetle mortality has been increasing recently. Mortality from the western pine beetle has been generally steady in Oregon and Washington. For fir engraver beetle, mortality trends had remained generally low up until 2013. Since then, mortality from fir engraver has been observed to be increasing in drought prone areas of Oregon. Statewide, damage from fir engraver observed in 2015 represented a 6-fold increase over 2013 levels (Buhl et al. 2016).

In regards to defoliators, acres defoliated from western spruce budworm in the Blue Mountains climbed rapidly from 2008 to 2011, but have declined markedly in recent years. Early detection traps for Douglas-fir tussock moths are set by the Forest Service and cooperators throughout eastern Oregon and Washington including the Blue Mountains. This network of traps is intended to detect building populations and predict impending outbreaks. Detected population levels have been very cyclic and generally increase about every 7 to 10 years. The last serious outbreak of Douglas-fir tussock moth in Oregon was in 2011.

Nationally, the spruce beetle epidemic has continued to intensify, particularly in Colorado and Wyoming, but spruce beetle populations within Oregon and neighboring regions of Idaho remain at endemic levels. The Blue Mountains do not have the large expanses of spruce that Colorado and Wyoming have and so do not have the same potential for large outbreaks. Mistletoe and root diseases are rarely accurately detected in aerial surveys and those disease agents do not contract or expand rapidly from year to year (Jenkins 2015).

A combination of aerial detection and ground surveys was used to characterize recent observed activity across Oregon statewide in 2015. The resulting report, “Forest Health Highlights in Oregon—2015” (Buhl et al. 2016) contained the following findings: An estimated 1.68 million trees were recently killed by insect, disease or animal damage across an area of 698,000 acres. The year 2015 was one of the warmest on record for Oregon and the related statewide drought conditions likely contributed to this large amount of detected tree mortality. Bark beetles such as Douglas-fir beetle, mountain pine beetle, western pine beetle, *Ips* and fir engraver contributed the majority of insect-related tree mortality. Also in 2015, a large amount of mountain pine beetle mortality was apparent in regions of the Malheur and Wallowa-Whitman National Forests. Most of Oregon’s observed annual Douglas-fir beetle mortality was centered in the Wallowa Mountains of the Wallowa-Whitman National Forest. Oregon’s fir engraver mortality for 2015 was also primarily found concentrated in northeast Oregon on the Umatilla and Wallowa-Whitman National Forests. As this bark beetle is strongly associated with drought stress, increased mortality is expected from fir engraver as competition-induced moisture stress continues to affect sites containing dense stands of grand fir.

Diplodia tip blight or pine shoot blight, caused by the fungus *Diplodia pinea* (syn. *Sphaeropsis sapinea*), was observed on ponderosa pine in many areas of northeast Oregon in 2015. This agent is a weak parasite that typically affects trees stressed by drought or other agents at times when conditions are ideal for infection and disease development. The primary symptom is “flagging” of branch tips, which occurs when the pathogen kills entire current-year shoots leaving obvious clusters of brown foliage at branch ends. In contrast to the needle cast diseases, needles affected

by this disease remain on the tree through the winter. Tree mortality is uncommon, but growth loss, branch dieback, and top-kill can occur (Buhl et al. 2016).

Invasive Pest Trends

The sap-sucking insect, balsam woolly adelgid, is a nonnative, invasive pest that has been established on the West Coast since 1929. It attacks various true firs in Oregon, primarily the subalpine fir in eastern Oregon. It feeds by piercing through bark, causing swelling, dieback on stems and branches, and for many trees, outright mortality within 3 to 4 years. Damage from the balsam woolly adelgid continues to be widespread and is currently affecting subalpine firs at high elevations across eastern Oregon. In 2015, approximately 61,000 acres of damage was mapped during aerial surveys. This was similar to the area detected in 2014. Although damage in recent years is below the 10-year average of 109,000 acres, infestations are chronic, thus declining damage detected in surveys may be due to mortality of preferred hosts (Buhl et al. 2016).

White pine blister rust disease is caused by a nonnative, invasive fungus (*Cronartium ribicola*). White pine blister rust affects all “five-needled” pines, but mainly western white pine and whitebark pine in this area. The disease causes formation of resinous cankers that commonly girdle the stems of host trees. This results in branch and top mortality of larger trees and it frequently kills smaller host trees. Trees infected by the fungus may also be predisposed to infestation by mountain pine beetle. White pine blister rust has significantly reduced populations of western white pine in the Blue Mountains, and is continuing to adversely affect whitebark pine as well. White pine blister rust represents a very significant threat to the vitality and survival of whitebark pine in the Blue Mountains, as it does to the species throughout most of its range (Aubry et al. 2008).

Susceptibility Reference Conditions

Much of the significance of the susceptibility or hazard modeling efforts as well as the current activity levels depends on the context of what level of historic insect and disease susceptibility is considered “normal.” Historically many outbreaks were likely severe, but several forest scientists have observed that uncharacteristically large insect outbreaks seem to have become more common in recent decades in many conifer forest types and they will likely continue to do so, particularly in the face of expected climate changes (Mitchell 1988; Logan et al. 2003; Bentz et al. 2009, 2010; Meddens et al. 2012; Sambaraju 2012; Kolb et al. 2016; Halofsky and Peterson 2016). Unprecedented range shifts are also becoming more prevalent. For example, mountain pine beetle has affected more than 32 million acres of western Canada since 1999, including areas at higher elevations and more northern latitudes than indicated by past records (Raffa et al. 2008).

To help provide more perspective regarding what might be considered historically normal levels of susceptibility to insects and diseases, Schmitt and Powell (2012) developed insect and disease susceptibility reference conditions based on the forest vegetation conditions expected to exist within the historical range of variability. For the purposes of this analysis, susceptibility was defined as the relative probability (low, moderate, high) of insect or disease agents being present and causing disturbance. The same nine insect and disease agent groups that were used in the risk hazard assessment of current conditions were evaluated in the context of more natural forest vegetation conditions. The resulting ranges are assumed to represent the insect or disease susceptibility associated with forest vegetation having little or no departure from reference conditions. While these ranges for the insect and disease susceptibility are based on vegetation conditions within the historical range of variability, they do also reflect some degree of professional judgment. However, they are generally consistent with information from other

published reports characterizing the susceptibility associated with early forest conditions (Hessburg et al. 1994; Swetnam et al. 1995). The susceptibility results identified for the various insect and disease agents refer to the relative probability of an insect or disease currently being present and causing damage, or to the existence of vegetation and site conditions contributing to an imminent level of risk.

The Schmitt and Powell (2012) characterization of historical range of variability for insect and disease susceptibility, as summarized in Table 311 (next page), indicates that managing forest vegetation structure, stand density, and species compositions to more closely resemble the historical range of variability would likely lead to stand conditions with low to moderate susceptibility to insects and diseases across the majority of the upland forest potential vegetation groups. These stand conditions would result in resilient forests capable of tolerating insect and disease disturbances while retaining their basic structure, ways of functioning, and their capacity for natural recovery.

Insects and Diseases – Environmental Consequences

Indirect Effects

All of the alternatives would manage forest insects and diseases under the concept of integrated pest management. Integrated pest management has many definitions, but the Forest Service's 1982 Planning Rule (36 CFR 219.3) characterizes it as a process for selecting strategies to regulate forest pests in which all aspects of a pest-host system are studied and weighed. The information considered in selecting appropriate strategies includes the impact of the unregulated pest population on various resources values, alternative regulatory tactics and strategies, and benefit/cost estimates for these alternative strategies. Regulatory strategies are based on sound silvicultural practices and ecology of the pest-host system and consist of a combination of tactics such as timber stand improvement plus selective use of pesticides. A basic principle in the choice of strategy is that it be ecologically compatible or acceptable.

Consistent with the principles of integrated pest management, all of the alternatives would make various use of silvicultural treatments such as commercial and noncommercial thinning, regeneration harvesting, tree planting, and prescribed burning as part of an insect and disease management program. Thinning and certain kinds of regeneration harvesting would be used to lower stand densities, reduce tree-to-tree competition, increase tree vigor, and thus provide an enhanced ability for trees to defend against attacks and infections. These treatments would also be used to manipulate species compositions in favor of more resistant species, and to enhance overall diversity, and thus, hedge risk. The development or establishment of multiple tree species would enhance resistance to host-specific insects or diseases and help ensure some portion of the affected forests can survive future outbreaks. Developing age class diversity at multiple scales across the landscape with regeneration harvesting and tree planting would dampen the effects of insects and diseases that preferentially target larger, older trees, and would ensure that the next generation of forest is available to replace stands killed during outbreaks. Treatments that remove excesses of multi-storied, layered stands would help mitigate the potential impact from defoliators by reducing the multi-storied structures in which some defoliators tend to thrive. Additional details about how these different treatments can be applied as resource management tools can be found in the "Ecological Resilience" section of Chapter 3.

Table 311. Range of expected susceptibility for each potential vegetation group if vegetation conditions were within the historical range of variability

Susceptibility to Insect or Disease	Dry Upland Forest	Moist Upland Forest	Cold Upland Forest
Defoliators - Low	40% to 85%	5% to 20%	40% to 95%
Defoliators - Medium	15% to 30%	20% to 30%	15% to 25%
Defoliators - High	5% to 15%	35% to 80%	5% to 10%
Douglas-fir beetles - Low	35% to 75%	30% to 60%	45% to 95%
Douglas-fir beetles - Medium	15% to 30%	20% to 40%	10% to 25%
Douglas-fir beetles - High	10% to 25%	10% to 30%	5% to 10%
Fir engraver – Low	45% to 95%	30% to 70%	35% to 75%
Fir Engraver – Medium	10% to 25%	10% to 20%	20% to 45%
Fir Engraver – High	5% to 10%	20% to 40%	5% to 10%
Spruce beetle – Low	0%	50% to 95%	10% to 30%
Spruce Beetle – Medium	0%	10% to 25%	30% to 50%
Spruce Beetle – High	0%	0% to 10%	20% to 50%
Bark beetles in ponderosa pine – Low	35% to 75%	30% to 65%	55% to 95%
Bark beetles in ponderosa pine – Medium	15% to 35%	15% to 30%	5% to 30%
Bark beetles in ponderosa pine – High	10% to 20%	15% to 35%	0% to 5%
Mountain pine beetle in lodgepole pine – Low	55% to 90%	30% to 60%	30% to 50%
Mountain pine beetle in lodgepole pine – Medium	5% to 35%	25% to 40%	15% to 40%
Mountain pine beetle in lodgepole pine – High	0% to 5%	5% to 30%	15% to 40%
Douglas-fir dwarf mistletoe – Low	30% to 60%	30% to 65%	40% to 90%
Douglas-fir dwarf mistletoe – Medium	10% to 35%	20% to 45%	20% to 30%
Douglas-fir dwarf mistletoe – High	20% to 35%	10% to 20%	0% to 10%
Larch dwarf mistletoe – Low	55% to 95%	5% to 20%	10% to 20%
Larch dwarf mistletoe – Medium	5% to 30%	15% to 40%	20% to 50%
Larch dwarf mistletoe – High	0% to 5%	40% to 70%	30% to 60%
Root diseases – Low	35% to 75%	5% to 25%	30% to 65%
Root diseases – Medium	20% to 35%	20% to 40%	20% to 45%
Root diseases – High	5% to 20%	35% to 65%	10% to 20%

Source: Schmitt and Powell (2012)

A degree of sanitation cutting would also be built into many of the silvicultural treatments used to manage insect and disease conditions. Sanitation harvesting focuses on the removal of trees that have either been infected or attacked, or appear to be in imminent danger from insects or pathogens. The main purpose of the sanitation element of the treatments would be to prevent these damaged individuals from serving as sources of population build-ups that could spread to large numbers of neighboring trees. Trees that have had previous bark beetle attacks, root disease infections or other damage can serve as “focus” trees. Some studies of bark beetles have indicated that these focus trees may play a role in how endemic beetle populations become epidemic (Eckberg 1994). Management of these focus trees while beetle populations are at endemic levels may help prevent development of epidemic outbreaks.

However, forest management cannot maintain low levels of vulnerability to insect and disease damage in all circumstances. First, not all areas of the forest landscapes will be managed intensively enough to result in meaningful changes to factors related to high susceptibility. For example, many members of the public value “unmanaged” forests that contain dense areas of large and old trees. Current and future insect and disease trends described earlier are expected to continue on the vast majority of the areas left untreated each year, until these acres are eventually restored to the desired conditions. Second, drought and warm temperatures are major drivers of many kinds of insect and disease outbreaks, and forest management by itself cannot entirely overcome these climatic effects.

It is also recognized that the types of treatments and strategies that are expected to be effective for mitigating susceptibility may be ineffective in terms of controlling outbreaks once they develop. There is considerable evidence that suppression of full-scale outbreak or epidemic conditions is virtually impossible after they have fully developed (Black 2005). Once an extensive outbreak has started, it is unlikely that silvicultural treatments can stop it. For example, under outbreak conditions, extreme numbers of bark beetles can overwhelm the defenses of even the healthiest trees, so preventative treatments often have little impact at that point. True epidemic conditions often only end when there are no more suitable host trees or when environmental conditions change.

The changes to forest vegetation conditions expected to occur under each of the alternatives are analyzed in detail within the “Forest Vegetation” section. The information presented here is a summary of those results. The alternatives that would result in the closest achievement of the historical range of variability and desired conditions for structural stages, species composition, and stand densities should result in the greatest reduction in insect and disease susceptibility. A landscape that contains a diversity of structural stages and species mixes generally consistent with that which evolved within the historic disturbance regimes would be more resilient to the effects of insect and disease activity.

The cold upland forest potential vegetation group is a relatively minor component of each National Forest and much of the cold upland forest has been allocated to management areas that would be unavailable for intensive management. The cold upland forest potential vegetation group exhibits the lowest insect and disease risk hazard, compared with the other upland forest potential vegetation groups. Relatively modest levels of active management were scheduled within the cold upland forest, so the results indicating degrees of change in the forest vegetation conditions of the cold upland forest for the different alternatives may be driven largely by natural disturbance effects. Therefore, changes to the forest vegetation conditions of the cold upland forest are not particularly useful as indicators of significant differences among the different management regimes of the alternatives.

The Umatilla and Wallowa-Whitman National Forests both have about half of their forest environment represented within the dry upland forest potential vegetation group, but they also have significant amounts of moist upland forest as well. Their dry upland forest landscapes are both currently severely departed from the desired conditions in terms of structural stages, stand density and species composition. The moist upland forests of these two forests are moderately departed from their desired conditions. The Malheur National Forest is somewhat distinct from the other two National Forests, in that it is dominated by dry upland forest and its moist upland forest represents only a very small piece of the overall forest landscape. While the species composition of the Malheur's dry upland forest is currently in reasonably good condition, the structural stages and stand density conditions are significantly departed from the desired conditions. Given that the dry upland forest is the most widely distributed among the Blue Mountains national forests, is the most highly departed from the desired vegetation conditions, and currently shows the highest levels of susceptibility to insect and disease damage, changes to the dry upland forest would seem to be the most relevant indicators of differences between the alternatives in terms of overall forest health.

Even if fully implemented, none of the alternatives would be able to completely correct all of the imbalances within the dry upland forest vegetation conditions within the next 20 years. However, substantial progress, particularly in terms of structural stages and stand density, could be achieved by fully implementing several of the alternatives. With its "front-loaded" harvest schedule objectives for thinning treatments, combined with a focus on the dry upland forest, E-Modified Departure would likely make the most progress toward moderating insect and disease susceptibility within the next 20-year timeframe. However, if the tradeoffs of implementing the departure schedule are considered too great in terms of either economics or negative side effects to other resources, then Alternatives D or E-Modified would also be highly beneficial options. Either of these alternatives would result in pronounced levels of improvement to the dry upland forest over the next 20 years, and associated reductions in overall insect and disease vulnerability. These alternatives would also entail considerably lower implementation costs than the departure alternatives.

Conversely, Alternatives A, B and C tend to consistently be the least effective in regards to addressing the restoration needs of the dry upland forest potential vegetation group. Generally, these alternatives would result in very little improvement to the significantly departed areas of the forest landscape, and in some circumstances, both the dry and moist upland forest vegetation conditions would be likely to degrade even further under the relatively limited levels of active management proposed by these alternatives. These alternatives would likely result in the continuation of relatively high levels of susceptibility to insect and disease damages over the next planning period.

The overall results support the idea that alternatives with robust thinning, regeneration and prescribed fire programs could be relatively successful in reversing the negative trends of the Blue Mountains national forests' vegetation conditions in terms of species composition, stand density and structural stages. However, alternatives that would maintain a disproportionate level of dense, overstocked stands, with understories composed of an excessive amount of shade tolerant species, would likely result in elevated levels of vulnerability to uncharacteristic insect and disease effects in the future.

Cumulative Effects

Potential cumulative effects were analyzed by considering the effects of the alternatives in the context of past, ongoing, and reasonably foreseeable future activities that have occurred within the vegetation cumulative effects analysis area. This analysis area consists of the 25 subbasins (HUC 4) that contain the Malheur, Umatilla, and Wallowa-Whitman National Forests and other lands. The time period into the future considered was 50 years.

The three National Forests of the Blue Mountains region are revising their forest plans simultaneously. These three individual revised plans will all contain the same desired conditions and will emphasize vegetation treatments that change the species composition, density, and structure in a similar fashion. With these three National Forests adjoining one another, the loosely coordinated efforts should complement each other in contributing to overall movement toward the historical range of variability and desired conditions for the restoration of landscape resiliency. Similar conditions for insect and disease susceptibility could be expected to result.

In July 2011, the Forest Service released a science-based strategy (the Western Bark Beetle Strategy) in response to the bark beetle infestation across forests of the interior west to ensure these forests provide healthy watersheds, stimulate local economies, are resilient to a changing climate and are ecologically restored over time. The strategy covered a 5-year period: from fiscal year 2011 to fiscal year 2016. The Western Bark Beetle Strategy recognized the bark beetle epidemic has been expanding, and infestations have accelerated in recent years across the West. The strategy also acknowledged that the situation required an increased response across the West and would require prioritized placement of treatments, integration of multiple program funds to achieve the maximum amount of priority treatments. The strategy was designed to address each of three aspects of the bark beetle situation: human safety, forest recovery, and long-term forest resiliency across Forest Service Regions 1 through 6.[7] The strategy has fostered an environment supportive of aggressively implementing projects to mitigate the effects of bark beetles in the western regions of the Forest Service. The strategy has also led to the development of scores of research publications and tools to increase the effectiveness of forest management practices and knowledge level regarding bark beetle mitigation (USDA Forest Service 2011b).

Large stand-replacing severe wildfires have increased in all three National Forests and on adjacent ownerships in recent years. These events are creating extensive areas of regenerating forests. There is concern that recent large, stand-replacing fires will synchronize forest development and commit landscapes to a future of increased disturbance, such as bark beetle outbreaks that require extensive, well-connected forests of host trees. Similarly, as more acres of natural conifer regeneration occur after wildfires and substantial bark beetle outbreaks, the risk would increase under all alternatives for the types of insects that target young buds, shoots, and branches to develop into extremely high populations.

Over much of last planning period, forest restoration efforts in the Blue Mountains have focused on addressing a long legacy of fire exclusion and historical timber harvesting practices that have created densely stocked stands, mostly at lower elevations. Active management has centered on improving the vigor of low-elevation dry forests and reducing fire hazard, primarily with mechanical treatments and prescribed fire. The level of active silvicultural management over the past planning period has largely been insufficient to reverse most of the undesirable conditions discussed in the previous sections. The abundance of relatively small-scale active management

[7] Regions 1 – 6 in order are the Northern, Rocky Mountain, Southwestern, Intermountain, Pacific Southwest, and Pacific Northwest Regions.

projects has contributed to a growing backlog of excess forest growth and continued movement away from the historical range of variability. Insect and disease outbreaks typically start in one or more places and spread in subsequent years to additional areas. The effects of these disturbances have the potential to spread to or from adjacent ownerships wherever the same host tree species are present. If outbreaks or epidemics develop as a result of favorable conditions on one ownership or area, the resulting populations could become so great that they are able to overwhelm adjacent areas, even though those areas had received preventative treatment.

One notable exception to the typical pattern of past management has been the award of a large-scale 10-year Integrated Resource Service Contract by the Malheur National Forest in 2013. This 10-year contractual obligation to supply substantial volumes of timber will entail a pace and scale of treatment that has not been utilized since early in the previous planning period. This project could very likely provide additional momentum to the planning and implementation of forest management projects by the Malheur National Forest for at least the remaining term of the contract. As the service contract work expands through subsequent annual task orders, a level of certainty is likely to continue to develop for local contractors, encouraging their investment in the infrastructure necessary to fully accomplish the level of treatments that are needed to effectively mitigate insect and disease risks across the Malheur and other eastside Oregon National Forests.

The greatest extent of foreseeable actions connected to the attainment of future forest restoration goals of the three National Forests is related to the ongoing Eastside Restoration Strategy. This effort, supported by the Pacific Northwest Regional Office of the Forest Service, started in 2013 as a way of putting resources toward, and a focus on, some different methods of planning and implementing forest restoration projects on the eastside National Forests of Oregon and Washington. Since 2013, the effort has supported the development of five Collaborative Forest Landscape Restoration projects and five Joint Chief's projects, which combine the forces of the Forest Service and the Natural Resources Conservation Service to restore forests and reduce fuel loadings across adjoining Federal and non-Federal lands in priority areas. The Blue Mountains Restoration Team has recently completed the Lower Joseph Creek Restoration Project Final Environmental Impact Statement and the Record of Decision for that implementation project authorizes approximately 17,000 acres of thinning treatments and up to 90,000 acres of prescribed burning. The same team is currently working on the landscape scale Blue Mountains Forest Resiliency Project, which encompasses parts of three National Forests in the Blue Mountains of Oregon and may cover up to 610,000 acres of treatments. All of these planning efforts will tend to support the future implementation of the revised Forest Plans and will aid efforts to treat lands across ownership boundaries.

The National Forests within the Blue Mountains have all implemented some levels of active restoration efforts for whitebark pine over the previous planning period. All of the alternatives for plan revision would contain desired conditions for whitebark pine to persist on the landscape, so restoration activities for this species would likely continue or intensify, contingent upon funding. If this tree species is eventually listed as a Federal threatened or endangered species, there could be ramifications to the efforts to control the effects of the invasive white pine blister rust disease within the Blue Mountains national forests. The additional legal constraints of the Endangered Species Act would entail requirements to ensure individual whitebark pines are not adversely affected or destroyed by either whitebark pine restoration actions, or related insect and disease management activities.

Wildland Fire and Fuels Treatments

Wildland Fire and Fuels – Affected Environment

A wildland fire is any non-structure fire that occurs in vegetation or natural fuels. Wildland fire includes both prescribed fires and wildfires. Prescribed fires are planned wildland fires that are ignited by management actions in accordance with applicable laws, policies, and regulations to meet specific objectives. A wildfire is an unplanned wildland fire including naturally caused ignitions, unauthorized human-caused fires, and escaped prescribed fire projects. Depending on the circumstances, wildfires may be managed to minimize impacts to values at risk or they may be managed to minimize the impacts of suppression activities on National Forest System lands.

Forest managers now recognize that past management practices have resulted in increased accumulations of live and dead vegetation, altered fuel arrangements, and changes in species composition (Agee 2003, Agee and Skinner 2005, Campbell 1996 and 2004, Lehmkuhl 1994, Parsons and DeBenedetti1979, Skinner 1995). When dead fallen material (including tree boles, tree and shrub branches, leaves, and decaying organic matter) accumulates on the ground, it increases fuel quantity and may create a continuous fuel bed. When this occurs, surface fires may ignite more quickly, burn with greater intensity, and spread more rapidly and extensively than in the past (Dennison 2014, Hardy 2005, Williams 2013). Certain land uses, such as grazing, can also sometimes reduce fine fuels, which impedes the development of periodic surface fires that would typically burn in these areas. Without fire, encroachment of trees into some historical savannah and grassland ecosystems may occur.

Ironically, effective fire suppression and exclusion efforts have, in many places, significantly altered natural fire regimes (circumstances of fires including frequency, intensity, and spatial extent) so that the fires of today tend to be uncharacteristically large and severe (Holsinger et al. 2016, Campbell 2004, Hessberg 2015, Peterson 2005). Addressing these changes, and the challenges they present, requires understanding and acceptance of the role of wildland fire, and the adoption of land management practices that integrate fire as an essential ecosystem process. The planning process considers the historical role of fire as an ecological disturbance agent. This knowledge is used to describe desired conditions and the baseline that future proposals will be working towards or maintaining (Powell 2001).

Wildland Fire Regimes

A fire regime is a generalized description of the role fire plays in the ecosystem (Agee 1993, Hann 2004; Heyerdahl 1996 & 2001; Sugihara 2006). It includes the characteristics of frequency, severity, and seasonality of fire. The historical fire regime is described according to our understanding of the occurrence and behavior of fires that occurred before significant European influence began in approximately 1850 (Jaindl et al. 1993). It also includes wildland fires ignited by Native Americans. Fire regimes, especially fire frequency and intensity characteristics, strongly influence which plant species will tend to dominate in the vegetation complex of a given area. Fire has been a significant disturbance process within the Plan Area historically and is essential to maintain key ecological processes. An understanding of fire regimes, ecological departure from historical reference conditions, and landscape pattern is an important part of modern land management. Land managers can mimic many of the effects of fire using management actions (timber harvest, prescribed fire, managing wildfire), but not always at the same scale or frequency as in historical disturbance regimes. Land managers have the ability to

choose, to some extent, what relationship with fire is desirable (Agee and Maruoka 1994, Brown 2004, Franklin 2012, Gartner 2008, Graham 2010, Hessberg 2015, Mutch 1993.).

Barrett et al. (2010) recognize five historical fire regimes (I – V). These five regimes include:

I – 0 to 35 year frequency and low (surface fires most common) to mixed severity (less than 75 percent of the dominant overstory vegetation replaced);

II – 0 to 35 year frequency and high (stand replacement) severity (greater than 75 percent of the dominant overstory vegetation replaced);

III – 35 to 100+ year frequency and mixed severity (less than 75 percent of the dominant overstory vegetation replaced);

IV – 35 to 100+ year frequency and high (stand replacement) severity (greater than 75 percent of the dominant overstory vegetation replaced);

V – 200+ year frequency and high (stand replacement) severity.

Table 312 displays historical fire regimes for the major vegetation types within the Plan Area and ranges of how often and to what degree historical fires exhibited severe fire behavior. Historical fire regime refers to the combination of fire frequencies and severities under which plant communities evolved and were maintained (Schmidt et al. 2002; Hardy et al. 2001). Frequency is expressed as a range of time between fire events. Effects on the dominant vegetation are expressed as fire severity and proportion of high severity fire.

Historical fire regimes I to IV were common and integral components of forested ecosystems in the Blue Mountains. Fire regime V (200-plus-year fire frequency) was relatively rare in this area (Heyerdahl and Agee 1996; Powell 2011).

Noteworthy fire history research has been accomplished within the Blue Mountains (Hall 1977, Crane and Fischer 1986, Agee and Maruoka 1994, Maruoka 1994, Heyerdahl and Agee 1996, Heyerdahl 1997, Olson 2000, Johnston et al. 2016). These studies have aided local efforts to establish historical fire return intervals. Fire size and patch size created within the perimeter of a historical fire have been the least studied element of fire history.

Table 312. Severity and frequency of fire (desired condition)

Potential Vegetation Group	Fire Regime	Fire Frequency (Years)	Percentage of Fire Behavior Typically of High Severity
Cold upland forest	IV	100-200	40-80%
Moist upland forest	III	30-150	20-40%
Dry upland forest	I	5-10	5-15%
Dry upland woodland	III	80-160	25-45%
Cold upland shrubland	III - IV	30-60	30-100%
Moist upland shrubland	II - III	10-40	30-100%
Dry upland shrubland	II	20-40	20-80%
Cold upland herbland	IV	30-80	55-100%
Moist upland herbland	II	20-40	20-80%
Dry upland herbland	II	5-20	40-80%
Cool/cold riparian forest	III - IV	100-200	40-90%

The results of this analysis are similar to those identified in broad-scale analyses that included the Blue Mountains and similar forest environments (Quigley et al. 1996, Quigley and Arbelbide 1997, MacDonald et al. 2005, Perry et al. 2011, Stine et al. 2014, Hessburg et al. 2016). The best available science (Hall 1977, Crane and Fischer 1986, Agee and Maruoka 1994, Maruoka 1994, Heyerdahl and Agee 1996, Heyerdahl 1997, Olson 2000, Johnston et al. 2016) supports the idea that the Blue Mountains evolved with frequent, low and mixed-severity fire. Approximately 88 percent of the Blue Mountains are classified as historical fire Regime I, II, or III, which are short to mixed return interval ecosystems (see Table 313). Sixty percent of the Blue Mountains are classified Fire Regime I, which are sites historically dominated by low to mixed severity frequent fires. Although dominated by low-severity fire behavior historically, approximately 5 to 15 percent of the acres burned within the dry upland forest potential vegetation group experienced high severity fire. Based on modeling of forest inventory data using the Forest Vegetation Simulator Fire and Fuels Extension (Reinhardt and Crookston 2003), approximately 40 to 60 percent of the acres within the dry upland forest potential vegetation group now have the potential to support high severity fire behavior under severe fire weather conditions. Increased potential for high severity fire in the dry upland forest potential vegetation group is largely due to the abundance of multi-storied stands with high stand densities. An increased potential for high severity fire in the dry upland forest potential vegetation group threatens the attainment of desired conditions for vegetation structure and economic outputs. The potential for high severity fire in the moist and cold upland forest potential vegetation groups (Fire Regimes III and IV) is currently close to what is estimated for historical levels (Countryman 2008).

Table 313. Percent of each national forest area historically in each wildfire regime

Fire Regime	Malheur	Umatilla	Wallowa-Whitman
I	60	55	53
II	23	3	5
III	15	28	25
IV	2	14	17
V	0	0	0

Wildland Fire Return Interval

The mean fire return interval is defined as the average period of time between fires within representative stands; that is, cluster scale data (Arno and Peterson 1983) as cited in the 2010 Fire Regime Condition Class Guidebook Version 3.0 (National Interagency Fire, Fuels, and Vegetation Technology Transfer 2010). For example, if a specific area consists of 10,000 acres and has a fire return interval of 100 years, then it would take approximately 100 years for a total of 10,000 acres within the area to burn. It does not mean that every acre within the area would have a fire every 100 years or that only 100 acres would burn each year. Because of the variability of fire processes, a specific site within the area could have a fire every 20 years, while other sites might not have fire reoccur for periods of greater than 100 years. The fire return interval is a generalized indicator of how much fire is or has occurred on the landscape. Higher numbers (longer fire return intervals) would mean that there is a greater period of time between fires, less area would burn, and there is less fire within the landscape. This is based on the total accumulation of fire within a specific area for a period of time.

Table 314 displays estimates of contemporary mean fire return intervals by potential vegetation group for each national forest, in comparison to reference conditions. The contemporary fire

return interval and the departure from reference conditions (LANDFIRE values) (The Nature Conservancy 2005) were calculated using the Blue Mountains geographic information systems database layer for wildfires from 1980 to 2017 and prescribed fire from 2001 to 2017. The Mean fire return interval was calculated by dividing the analysis area size by the average acres burned per year for each potential vegetation group (see Table 314).

Table 314. Current fire return intervals (in years, since 1980) for each national forest, in comparison to reference conditions, by potential vegetation group

Potential Vegetation Group	Malheur	Umatilla	Wallowa-Whitman	Blue Mountains National Forests	LANDFIRE Reference (years)	Blue Mountains Forest Plan Revision Reference (years)*
Cold upland forest	99	123	246	161	113	100-200
Whitebark pine forest	45	no data	301	182	63	30-120
Moist upland forest	249	255	270	256	71	30-150
Dry upland forest	616	114	148	213	20	5-25
Juniper woodland	43	152	105	75	48	80-160
Dry herbland	108	133	181	144	8	5-20
Dry shrubland	142	226	96	89	74	75-125
Cold herbland**	no data	no data	147	180	239	30-80
Moist herbland	no data	177	198	186	30	20-40
Moist shrubland	163	58	176	100	20	10-40

* The reference values were derived from version 2.1 of the LANDFIRE reference condition modeling manual (The Nature Conservancy, 2005) and associated reference condition summary tables. Reference values were also based on work by Crane and Fischer (1986), Agee (1993 and 2003), Maruoka (1994), Heyerdahl and Agee (1996), Olson (2000), and Catherine Macdonald (2005).

** No data = Potential Vegetation Groups less than 1% of national Forests acres were not modeled.

Fire return intervals within most of the potential vegetation groups currently exceed reference condition ranges due to fire exclusion and suppression. This is especially evident in the dry upland forest potential vegetation group. Estimates of the present fire return interval in the dry upland forest potential vegetation group is 213 years at the scale of the Blue Mountains. Historically, the dry upland forest potential vegetation group was characterized by predominantly frequent, low to mixed-severity surface fires occurring every 5 to 25 years. While larger-diameter, old ponderosa pine and Douglas-fir typically survived these low-severity fires, most younger, smaller-diameter trees and less fire-tolerant species were killed. The historical fire regime created and maintained a generally open forest structure, with a small-scale mosaic pattern of clumps or patches of trees dominated by large diameter, old ponderosa pines, scattered individual trees, and openings that contained an abundance of native grasses and shrubs (Churchill et al. 2013, Larson and Churchill 2012, and Franklin et al. 2008). This spatial heterogeneity is a key structural element of the historical dry upland forest (Franklin et al. 2008). Crown fires may have occurred historically in mid- to late-seral closed canopy structural stages. However, these events were limited in extent due to the predominance of open canopy forest (Barrett et al. 2010). The frequent fires in the dry upland forest potential vegetation group also contributed to relatively low fuel loadings. Due to over a century of fire exclusion and suppression, the dry upland forest

potential vegetation group in general has experienced a greater number of missed fires. As a result, the dry upland forest potential vegetation group has experienced the greatest amount of departure from the historical range of variability.

The estimated current fire return interval is closer to the historical reference condition range in the cold upland forest potential vegetation group. The cold upland forest potential vegetation group was characterized by stand-replacing fire events that occurred very infrequently, generally greater than 100 year return intervals. Due to a fewer number of missed fires, the cold upland forest potential vegetation group tends to be less departed from the historical range of variability.

Within the moist upland forest potential vegetation group, the estimated current fire return interval is approximately 256 years at the scale of the Blue Mountains. Historically, the moist upland forest potential vegetation group was characterized by mixed-severity fires occurring every 30 to 150 years. Mixed-severity fires alternated between stand-replacing crown fires, which killed all trees, to nonlethal, low-intensity surface fires that left patches of living trees. According to Perry et al. (2011), mixed-severity fires created a patchiness of forest structure, composition, and seral status that could be observed and quantified at an intermediate scale, with patch sizes ranging from a few hundredths up to tens or hundreds of acres, depending on local and climatic drivers. In forest types that were historically dominated by mixed-severity fire regimes, surface and canopy fuels, topography, climatic conditions, and ignitions worked in concert to influence variation in fire frequency, severity, spatial extent, and seasonality. The result was a complex spatial-temporal mix of low, moderate, and high severity patches. Due to patterns of burning, this type of historical fire regime created a complex mosaic pattern across the landscape, resulting in high levels of diversity in both plants and animals (Perry et al. 2011; Stine et al. 2014). Due to over a century of fire exclusion and suppression, the moist upland forest potential vegetation group in general has experienced a fewer number of missed fires than the dry upland forest potential vegetation group but a greater number than the cold upland forest potential vegetation group. As a result, the moist upland forest potential vegetation group tends to exhibit a relatively moderate amount of departure from the historical range of variability.

In most cases, fire has become more frequent since 1980 than in the last 100 year time period (ICBEMP 2014) (Hessburg 2006). Some of this is possibly due to variations in the climate, but most of the changes are due to the buildup in fuels and increase in multi-storied, dense stands of fire vulnerable species. Hessburg et al. (2016) combined a tree-ring-based fire history with 20th-century area burned showed that changes in the wildfire regime in the Sierra Nevada mountains over the last 400 years corresponded with socioecological change, not climate variability. Rarely, dry forest landscapes were affected by more severe climate-driven events. Extant dry forests no longer appear or function as they once did. Large landscapes are homogeneous in their composition and structure, and the regional landscape is set up for severe, large fire and insect disturbance events. (Hessburg et al. 2005) The result of having the current, less frequent fire return interval in the dry vegetation types is that vegetation and fuel loading can build up and lead to more severe and larger fires than historical levels.

Wildland Fire Severity

Fire severity, as discussed in this section, is a measure of the potential effects of fire on vegetation. The following definitions and thresholds used are from the Fire Regime Condition Class Guidebook version 3.0 and arte consistent with ongoing LANDFIRE definitions:

- **Low severity fire:** less than 25 percent mortality in the dominant overstory vegetation.

- **Mixed severity fire:** 25 to 75 percent mortality in the dominant overstory vegetation.
- **High severity fire:** greater than 75 percent mortality in the dominant overstory vegetation.

Continuous vegetation survey (CVS) inventory plot data for the Blue Mountains Plan Area was used to estimate potential mortality from fire. The summary of this data for percent high severity fire at the scale of each national forest is summarized in Table 315. Values were obtained using the FVS fire and fuels extension model.

Table 315. Potential percent high severity fire by potential vegetation group* for each national forest

Potential Vegetation Group	LANDFIRE Reference Value (high severity fire)	Malheur	Umatilla	Wallowa-Whitman
Cold upland forest	84%	55%	52%	55%
Moist upland forest	35%	38%	40%	32%
Dry upland forest	10%	50%	55%	50%
Juniper woodland	37%	89%	100%	94%

* Value: percent of the potential vegetation group that has the potential (based on CVS data) for greater than 75 percent basal area loss in the event of a fire at 90th percentile conditions. Greater than 75 percent basal area mortality is defined as a high severity fire. Grassland, herbland, and brush potential vegetation groups are modeled as high severity fire regimes tending to vegetative replacement fires and as such are not listed.

Table 315 displays the potential for high severity fire effects by potential vegetation group and national forest. Fire severity data indicate that under severe fire weather conditions (90th percentile), much of the analysis area has the potential for high severity fire effects. The moist upland forest potential vegetation group exhibits the least amount of departure from reference conditions. Currently, approximately 32 to 40 percent of the moist upland forest potential vegetation group in the Blue Mountains national forests has the potential for high severity fire, compared to a reference value of 35 percent. Approximately 52 to 55 percent of the cold upland forest potential vegetation group in the Blue Mountains national forests has the potential for high severity fire, compared to a reference value of 84 percent. Even though the cold and moist upland forest potential vegetation groups show the potential for a moderate to high amount of high severity fire, this amount of fire is consistent with the mixed to infrequent high severity fire regimes that historically dominated these systems. Approximately 50 to 55 percent of the dry upland forest potential vegetation group has the potential for high severity fire, compared to a reference condition of 10 percent. This increased potential for high severity fire in the dry upland forest potential vegetation group results in increased risk of loss of key ecosystem components. High potential for high severity fire can be attributed to stands that have canopy cover greater than the desired conditions, an abundance of small diameter understory trees that act as ladder fuels and carry wildfire from the ground into the overstory tree crowns, or a level of down woody material that exceeds the desired condition.

Fire Regime Condition Class

Fire regime condition class is a way of classifying the current degree of change from the natural fire regimes and their characteristic vegetation and fuel conditions (Hann 2004, Powell 1998 and 2001). There are three condition classes for each fire regime and each classification is based on a departure score that indicates the relative amount of departure from the historical regime. The departure score can be thought of as being a product of two major elements: the condition of the

vegetation and the fire frequency/severity. The three fire regime condition classes that can result from this type of analysis are described in the table below:

Table 316. Description of fire regime condition classes (Schmidt et al. 2002)

Fire Regime Condition Class	Description	Risk
Condition Class 1	Within the natural (historical) range of variability of vegetation characteristics, fuel composition, fire frequency, severity and pattern, and other associated disturbances. **Low Departure**	• Fire behavior, effects, and other associated disturbances are similar to those that occurred prior to fire exclusion (suppression) and other types of management that do not mimic the natural fire regime and associated vegetation and fuel characteristics. • Composition and structure of vegetation and fuels are similar to the structure that existed under the natural (historical) fire regime. • Risk of loss of key ecosystem components (e.g., native species, large trees, and soil) is low.
Condition Class 2	Moderate departure from the natural (historical) range of variability of vegetation characteristics, fuel composition, fire frequency, severity and pattern, and other associated disturbances. **Moderate Departure**	• Fire behavior, effects, and other associated disturbances are moderately departed from historical range of variability (more or less severe). • Composition and structure of vegetation and fuel are moderately altered. • Uncharacteristic conditions range from low to moderate. • Risk of loss of key ecosystem components is moderate.
Condition Class 3	High departure from the natural (historical) range of variability of vegetation characteristics, fuel composition, fire frequency, severity and pattern, and other associated disturbances. **High Departure**	• Fire behavior, effects, and other associated disturbances are highly departed from historical range of variability (more or less severe). • Composition and structure of vegetation and fuel are highly altered. • Uncharacteristic conditions range from moderate to high. • Risk of loss of key ecosystem components is high.

As described above, the determination of the three fire regime condition classes for each fire regime includes an assessment of the relative amount of departure of current fire frequency/severity from the historical natural fire regime (Hann et al. 2003). The degree of departure ideally can be thought of as being a product of two major elements: the condition of vegetation succession classes and fire frequency/severity. The existing departure of fire severity is described qualitatively in this section as a part of the affected environment, but is not analyzed for each alternative as a quantitative part of fire regime condition class. In most cases, the departure of fire frequency would overwhelm the departure of the vegetation conditions, making interpretation of changes in vegetation structure difficult. For the this analysis, the fire regime condition class modeling focuses on vegetation so that the effects of proposed management on vegetation attributes, such as structure, density, and species composition, can be displayed more easily and clearly.

To characterize the fire regime condition class in this analysis, the degree of departure from the natural fire regime utilized a vegetation departure index value that focuses on vegetation and does not include an evaluation of the current fire severity/frequency as a quantitative part of the score.

The vegetation departure index quantifies the degree to which the vegetation structure, size class and stand density have departed from desired conditions. The computation of the vegetation departure index values is based on the succession class vegetation departure calculations as outlined in the Interagency Fire Regime Condition Class Guidebook (Barrett et al. 2010). Vegetation output data from the Vegetation Development Dynamics Tool model (ESSA Technologies Ltd. 2007) runs for each of the three upland forest potential vegetation groups was classified into one of the five vegetation-succession classes (see the “Forest Vegetation” section of Chapter 3 for more information on the vegetation modeling). The acres existing in each succession class for each potential vegetation group were then expressed as a percentage of the total potential vegetation group. Reference values for each succession class were developed based on the midpoints of the forest vegetation’s historical ranges of variability. Current and projected forest vegetation succession class percentages were compared to the reference values to determine the percentage of similarity between the current and reference amounts. The sum of these values for all five succession classes is the similarity index. The vegetation “departure” index is simply the inverse of the similarity index (100 – similarity index).

Table 317 displays the forestwide vegetation departure index values of the existing forest vegetation. The higher values indicate forest vegetation/fuel conditions that are significantly departed from the conditions expected under a natural fire regime. The vegetation departure index is used in this analysis as an inference of the overall fire regime condition class. The index value classes that correspond to the fire regime condition classes include the following:

Low departure (less than 33 percent) Condition Class 1: Composition and structure of forest vegetation is similar to the historical range of variation and levels of natural resilience to disturbance are generally high. Risk of losing key ecosystem components (e.g., native species, forest structure, soil) is minimal to low.

Moderate departure (between 33 and 66 percent) Condition Class 2: Composition and structure of forest vegetation is significantly altered from the historical range of variation and the risk of losing key ecosystem components ranges from moderate to high. Areas within this class will likely need moderate levels of restoration treatments (e.g., fire, mechanical) to be restored to resilient conditions.

High departure (more than 66 percent) Condition Class 3: Composition and structure of forest vegetation is highly altered from the historical range of variation and the risk of losing key ecosystem components ranges from high to very high. Areas within this class will likely need significant levels of restoration treatments (e.g., fire, mechanical) to be restored to resilient conditions.

Table 317. Existing condition vegetation departure index values (zero-100) for each national forest

Potential Vegetation Group	Malheur	Umatilla	Wallowa-Whitman
Cold upland forest	54	13	38
Moist upland forest	37	27	23
Dry upland forest	62	60	57

The dry upland forest potential vegetation group consistently exhibits vegetation departure index values at the high end of moderately departed, or fire regime condition class 2. These vegetation departure index values indicate that vegetation conditions are nearing a highly departed state with

a high risk of loss of key ecosystem functions. Additional discussion can be found in the Ecological Resilience and Forest Vegetation sections, but the amount of departure within the dry upland forest potential vegetation group typically reflects an overabundance of shade tolerant tree species, overabundance of high density forest conditions, excess of multi-storied stand structures, and a deficit of old and mature fire resistant individual trees. The uncharacteristic condition of the dry upland forest potential vegetation group is of particular concern as it represents the dominant forest vegetation group across the Blue Mountains national forests.

Within the moist upland forest potential vegetation group, vegetation departure index values vary by national forest. Within the Umatilla and Wallowa-Whitman National Forests, the vegetation departure index indicates that most of the moist upland forests are in fire regime condition class 1 and are within the historical range of variability. These scores indicate that the composition and structure of vegetation and fuels are similar to the characteristics exhibited under the natural (historical) fire regime and are at low risk of loose of key ecosystem components in the moist upland forest potential vegetation group. However, within the Malheur National Forest, the vegetation departure index indicates that the moist upland forest vegetation is moderately departed and exists in fire regime condition class 2. This score indicates that the composition and structure of vegetation and fuels are becoming more departed from the characteristics exhibited under the natural (historical) fire regime and are at moderate risk of loose of key ecosystem components in the moist upland forest potential vegetation group within the Malheur National Forest.

Within the cold upland forest potential vegetation group, vegetation departure index values also vary among the three National Forests. The Umatilla National Forest's cold upland forest vegetation exhibits a low degree of departure and is in fire regime condition class 1. However, within the Wallowa-Whitman and Malheur National Forests, the cold upland forest vegetation is currently moderately departed and in fire regime condition class 2.

It is important to note that the analysis above was done at a forest-wide landscape scale. Assessments completed at smaller spatial scales, like basins, watersheds or sub-watersheds may not correspond with these forest level conditions.

These trends and altered forest vegetation conditions of the dry and moist mixed conifer in the Blue Mountains are similar to those described for years by numerous forest scientists and ecologists including Agee (1993), Quigley et al. (1996), Macdonald et al. (2005), Stine et al. (2014), Franklin et al. (2014), Haugo et al. (2015), Hessburg et al. (2005), Hessburg et al. (2015), Hessburg et al. (2016) and Johnston (2016). Science shows that fire-adapted forests like many of those found in the Blue Mountains are dominated by ecosystems that historically evolved with frequent, low and mixed severity fire. The vast majority of these forests are classified as historical Fire Regime I, II, or III. These are short to medium length fire return interval systems. Much of this landscape is currently moderately to highly departed from historical/reference conditions for vegetation and fuel conditions.

A small number of scientists contend these views (Williams and Baker 2012), but most scientists today agree that these forests neither resemble nor function as they once did. Density and fuel loadings within dry and moist conifer forests and landscapes particularly have increased dramatically as a result of human activities including decades of wildfire suppression resulting in fire exclusion. Wildfire suppression, which was formally adopted as policy by the U.S. Forest Service over 100 years ago and became effective in the 1930s, was another major influence. Dry upland forests and areas of moist upland forests that historically experienced relatively frequent,

low and mixed severity fires have now missed what would have been a natural recurrence of several wildland fires due to decades of fire exclusion and suppression. Tree regeneration that naturally would have been thinned by fire continued to grow into dense stands of fire-vulnerable species, ultimately forming multi-storied, closed canopy structures. The historically open stands within the dry upland forest potential vegetation group, with their typical mosaic pattern of tree clumps and openings, have now filled in with younger trees, resulting in a more uniform stand structure, increased ladder fuels, increased stand densities, increased fuel continuity, and decreased variety of spatial patterns. Increased stand densities and a reduction in low severity wildfire events on dry and moist sites has also contributed to a shift from fire tolerant tree species, such as ponderosa pine or western larch, to more shade tolerant and fire vulnerable species, such as grand fir. As a result, large areas of these forests are at significant risk of losing key ecosystem components.

Wildland Fire and Fuels Treatments – Environmental Consequences

All of the alternatives use wildland fire in order to maintain public land conditions within the historical range of variation while, at the same time, recognizing that other resource and social values may determine the appropriate management responses. Managed use of unplanned natural wildfire, along with mechanical and other fuels management strategies, may contribute to forest conditions that meet desired conditions for the potential natural vegetation types within the Plan Area.

Fuel Treatment Management Activities

Reducing fire hazard means returning forests to historic vegetation composition, structure, and fire return intervals. In these situations, fuels reduction objectives are largely in line with restoration objectives. Therefore, in terms of the amount and pattern of thinning and application of fire, prescriptions for fuels reduction projects in fire-prone forests would strive to meet restoration objectives.

The forests currently use prescribed burns and mechanical treatments in order to achieve multiple objectives, including reduction of activity-generated and natural fuels, wildlife habitat improvement, ecosystem restoration, and range betterment. While management techniques (including mechanical removal) may be used in order to reduce heavy fuels, they cannot always completely replace the ecological role that fire plays. Fire not only reduces the build-up of dead and downed fuel, it performs many other critical ecosystem functions. Fire can recycle nutrients that might otherwise be trapped for long periods of time in the dead organic matter that exists in many environments with slow rates of decay. It can also stimulate the production of nutrients and provide the specific conditions (including seed release, soil, light, and nutrients) that are critical for the reproduction of fire-dependent species Long et al. 2009, Thomas and Agee (1986), and Fieder (2000).

For all alternatives, limitations to landscape-level fire management activities may include funding uncertainty, organizational capacity of the Forest Service, species at risk, wildland-urban interface issues, sensitive watershed concerns, local and regional fire activity, fuel moistures, and air quality issues related to smoke. Fuels treatments, including prescribed fire and management of unplanned wildfire, would be utilized under all of the alternatives. However, the level and type of management activity would vary by alternative.

Table 318 displays the level of prescribed fire and mechanical fuel-reduction activity associated with each alternative by national forest.

Table 318. Annual acres of fuels treatments for each National Forest by alternative

National Forest	Activity	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. E-Mod.	Alt. E-Mod. Dep.	Alt. F
Malheur	Prescribed burning outside of harvest units	9,500	9,500	9,500	0	9,500	9,500	9,500	9,500
Malheur	Prescribed burning inside of harvest units	5,300	5,300	2,500	5,100	9,400	9,400	14,800	6,200
Malheur	Treatment or removal of fuels with ground-based equipment inside of harvest units	1,800	1,800	900	15,400	3,100	3,100	4,900	2,100
Umatilla	Prescribed burning outside of harvest units	10,000	10,000	10,000	0	10,000	10,000	10,000	10,000
Umatilla	Prescribed burning inside of harvest units	3,900	3,900	1,700	4,000	5,550	5,550	10,700	4,800
Umatilla	Treatment or removal of fuels with ground-based equipment inside of harvest units	1,300	1,300	600	12,000	1,850	1,850	3,600	1,600
Wallowa-Whitman	Prescribed burning outside of harvest units	10,500	10,500	10,500	0	10,500	10,500	10,500	10,500
Wallowa-Whitman	Prescribed burning inside of harvest units	3,400	3,450	1,550	4,300	7,050	6,975	12,375	4,550
Wallowa-Whitman	Treatment or removal of fuels with ground-based equipment inside of harvest units	1,100	1,100	500	12,700	2,300	2,325	4,125	1,500

It was assumed in the design of each alternative that all activity-generated fuels would be reduced to levels meeting the desired conditions for down wood. The mix of fuels treatments would be a combination of thinning, removal of small diameter biomass, mastication, piling and burning, or just burning. The three National Forests have averaged a combined 20,000 acres of prescribed fire per year over the last 10 years. The Malheur has conducted 6,300 acres of prescribed fire, the Umatilla 5,800 acres, and the Wallowa-Whitman 7,400 acres (FACTS Database 10/24/2017).

The level of prescribed burning occurring outside of harvest units would not differ between the alternatives, except under Alternative D. Under all other alternatives, prescribed burning outside of harvest units would continue at the current rate of approximately 20,000 acres per year within the Blue Mountains national forests. The use of prescribed fire outside of harvest units would be eliminated under Alternative D. Prescribed fire occurring outside of timber harvest units may or may not use thinning or piling as a pretreatment, depending on anticipated fire effects in relation to the desired conditions. For example, a proposed prescribed fire in an area that has an abundance of multi-storied stands may have a high potential for high severity fire effects. However, if the desired condition for the area is low severity fire, it would be necessary to complete pretreatments to bring potential effects in alignment with the desired conditions.

Under Alternatives A and B, prescribed burning and the treatment of fuels with ground-based equipment within harvest units would continue at the current rate of approximately 16,800 acres per year within the Blue Mountains national forests. Under Alternative C, these same treatments within harvest units would decrease to approximately 7,750 acres within the Blue Mountains national forests due to the decrease in the level of timber harvest. With Alternative D, the

treatment of fuels within harvest units would increase substantially to approximately 53,500 acres per year due to the substantial increase in timber harvest proposed under this alternative. Under Alternative D, the majority of the fuels treatments occurring within the harvest units would be accomplished by removal or crushing, instead of burning. With Alternatives E and E-Modified, the treatment of fuels using fire and/or ground-based equipment within harvest units would increase to approximately 29,200 acres within the Blue Mountains national forests. Under Alternative F, the treatment of fuels using fire and/or ground-based equipment within harvest units would increase to approximately 20,750 acres within the Blue Mountains national forests. Similar to Alternative D, Alternative E-Modified Departure would also substantially increase the treatment of fuels within harvest units to about 50,500 acres per year due to the increased levels of timber harvesting allowed under this alternative. However, with E-Modified Departure, most of the fuel reduction treatments would be accomplished with prescribed fire rather than crushing or removal. With all of the other alternatives except Alternative D, the majority of the fuels treatments within the harvest units would be accomplished using fire, instead of removal or crushing the fuels.

The overall goal of these fuel treatments in the wildland is to not to prevent the occurrence of fire or facilitate suppression activities, but rather to create conditions in which fire can occur without unacceptably destructive consequences (Reinhardt et al. 2008). Some of the key principles that are most important in terms of designing fuel reduction treatments are reducing surface fuels, increasing the height to live crown, decreasing crown density, and retaining large trees of fire resistant species. Prescribed fire, mechanical thinning, and pile burning can all be useful tools to achieve these objectives (Agee and Skinner 2005).

The use of mechanical fuels treatments (thinning, crushing, piling, grinding) combined with removal of fuels would reduce the total amount of woody fuel on a site and reduce the potential fire severity effects on the soil. These activities would also be designed to reduce the average distance between ground fuels (reduced ladder fuels) and the lower crown of the trees, thereby reducing the potential for crown fire (Agee and Skinner 2005). Thinning of trees while emphasizing retention of large fire resistant individuals will reduce average stand density, favor less shade tolerant fire resistant species, reduce canopy fuel loads and break up fuel continuity within a stand.

However, studies have demonstrated that using either mechanical treatment or prescribed burning as standalone treatments is less effective than combining the two. Stephens et al. (2009), reporting on the effects of the National Fire and Fire Surrogate study, found that fire performance analysis conducted at six western sites, including one in the Blue Mountains, indicated that treatments combining mechanical thinning and prescribed fire were the most effective fuel treatments in dry forest systems. Similarly, Kalies and Yokum Kent's (2016) review of 56 separate science studies addressing fuel treatment effectiveness in eight western U.S. states found that overall, the evidence strongly supports that treatments which combine mechanical thinning and prescribed burning are effective in reducing fire severity, tree mortality, and crown damage.

Burn treatments alone often have little effect on live stand structure and overall density. Mechanical treatments alone, on the other hand, are effective at decreasing basal and stand density, but they have little effect in reducing surface fuels and perform poorly as a surrogate for fire for the great majority of ecological variables (McIver et al. 2012). Alternatives like C or D, which lean very heavily toward one approach at the exclusion of the other, will be less effective in managing fuels and potential fire behavior while meeting ecological needs than alternatives which effectively combine both treatment methods.

In addition to the activities listed above in Table 318, unplanned naturally ignited wildfires may also be managed to achieve desired conditions under all of the alternatives. Naturally ignited wildfires managed for resource benefits would result from the application of the appropriate management response in order to accomplish specific resource management objectives in predefined designated areas outlined in fire management plans. In some circumstances, these wildfires would be used in order to protect, maintain, and enhance resources and, as nearly as possible, be allowed to function in their natural ecological role. The use of unplanned ignitions as a tool to meet resource objectives could occur on all acres under all alternatives, as long as those fires are moving the landscape towards, or helping maintain, the desired conditions for the area. However, only Alternatives C, E, E-Modified, E-Modified Departure, and F would contain specific objective statements in terms of the number of acres of wildfire managed for resource benefits per decade to achieve desired conditions for species composition, stand densities, structural stages, fire frequency, fire severity, and fire regime condition class. Management of unplanned ignitions is guided by a national forest's fire management plan. A fire management plan is a decision support tool required by federal fire policy that aids decision makers and fire personnel in the determination of management response to an unplanned ignition. Alternative C contains the greatest acreage objective of unplanned ignitions managed for resource benefits due to an increased emphasis on more passive forest management to achieve desired conditions. Alternatives B and D would not contain a specific acreage objective for unplanned ignitions managed for resource benefits; however, the use of unplanned ignitions managed for resource benefits would not be precluded. A complete list of objectives for each national forest is available in Appendix A.

Wildland Fire Effects

For all of the alternatives, the continued introduction of fire is vital to the health, functioning, and sustainability of the ecosystem. Fire contributes to multiple ecological functions and processes, with effects varying depending on fire intensity, severity, and frequency. Intensity, severity, and frequency are the defining factors of a fire regime. The use of both planned ignitions (prescribed fire) and unplanned ignitions (wildfire) may result in the following effects on vegetation.

Moderate to High-severity Fire Effects

- Varying levels of mortality in both overstory and understory trees, which results in reduced tree densities, decreased competition between trees for moisture, nutrients, and sunlight, and increased tree health, growth, and vigor of the residual trees.
- Creation of snags and large woody material as surface fuels, which improves wildlife habitat values.
- Restoration and/or maintenance of meadow inclusions, grasslands, and shrublands where conifers have encroached due to fire suppression/exclusion.
- Stimulation of prolific vegetative regeneration and expansion of tree species such as aspen.

Low to Moderate-severity Fire Effects

- Modified species composition, favoring more fire tolerant tree species with thicker bark (ponderosa pine, older grand fir and Douglas-fir).
- Thinning of seedlings and smaller diameter trees.
- Maintenance of historical, low- and mixed-severity fire regimes by periodic reduction of accumulated biomass and downed woody debris.

- Scorched tree bark, which can attract bark beetles and increase the risk of attack and mortality in the short-term.
- Scorched lower branches of tree crowns, thereby increasing crown base height, decreasing the potential for ground fires to transition to crown fires, and reducing fire severity.
- Favoring the spread or deterring the establishment and proliferation of noxious weeds, depending on fire frequency, severity, and timing.
- Stimulated vegetative shoot/bud initiation (provided soil moisture remains favorable) that results in a more leafy and palatable forage regrowth.
- Sanitizing effect on trees infected with dwarf mistletoe by scorching brooms in the lower crowns or by completely killing heavily infected trees.

Litter and duff can have an insulating effect on soil, which acts to lower soil temperatures and delay spring growth and herbage. Increased litter and duff can also result in decreased growing space for plants and decreased understory productivity. Fire results in reduced litter and duff accumulations. Fire, especially in combination with reduced stand densities, results in changes in the microclimate on the forest floor, specifically increased sunlight penetration, increased soil temperatures, and increased understory productivity. Fire has been shown to result in substantial increases in understory productivity and diversity. Low intensity fire in conjunction with reduced stand densities my improve overall ecosystem function by increasing rates of decomposition and nutrient cycling, water availability, carbon storage, plant diversity, and populations of native wildlife species (Kalies and Yokum Kent, 2016). Fire may rejuvenate desirable grasses, depending on the species response to disturbance. Fire may also increase seedling establishment by aiding in seedbed and site preparation. By decreasing litter and duff accumulation, fire also decreases fuel loadings in general and aids in the maintaining of conditions favoring future low fire severity fire.

Within the dry upland forest potential vegetation group, tree densities may be reduced by fire, although not always in a uniform way. Low- to mixed severity fire may result in a tree arrangement consisting of clumps of trees interspersed with openings. Low severity to mixed fire is necessary to the maintenance of open, park-like stands dominated by fire resistant species, such as ponderosa pine. Low to mixed-severity fire in mixed size and multi-storied stands could favor larger diameter trees and create stands with minimal amounts of understory, which perpetuates low severity fire Prichard, Peterson, and Jacobsen (2006).

Within the moist upland forest potential vegetation group, planned and unplanned ignitions may result in mixed-severity fire events. Mixed-severity fire alternates between stand-replacing crown fires that kill all trees and nonlethal, low-intensity surface fires that leave patches of living trees. Due to complex burning patterns, this type of fire tends to create a mosaic pattern across the landscape. Large openings created by stand-replacing crown fires may result in regeneration of more shade-intolerant/fire tolerant and/or early seral tree species.

Within the cold upland forest potential vegetation group, planned and unplanned ignitions may result in stand-replacing fire events. Stand-replacing fire events are characterized by crown fire that kills most or all of both the overstory and understory trees across large areas.

The emphasis on treating National Forest System lands adjacent to wildland-urban interface areas would continue into the foreseeable future. The wildland-urban interface has been defined and identified through national efforts and additional wildland-urban interface would continue to be

identified and refined through completion of community wildfire protection plans. Treatments in highly departed fire regime condition classes would occur in all alternatives. Effects on forest management related to unplanned ignitions do not vary widely among the alternatives. For all of the alternatives, the appropriate protection response would be taken where life or values are at risk, while meeting the desired conditions.

Effects to Fire Regime Condition Class

The expected changes in fire regime condition class under each of the alternatives would vary depending on the combined amount of management activities, including prescribed fire, timber harvest, mechanical fuels treatments, and natural changes such as tree growth and succession, insect and disease-related mortality, and mortality due to wildfire. Forest vegetation condition data from the Vegetation Development Dynamics Tool model (ESSA Technologies Ltd. 2007) projected over a 20 and 50 year timeframe were analyzed for each of the three upland forest potential vegetation groups and then classified into one of five vegetation-succession classes (see the Forest Vegetation section of Chapter 3 for more information on the vegetation modeling). The vegetation departure index values were then calculated and used to track the effects of the various alternatives on the fire regime condition class over time.

Dry Upland Forest – Fire Regime Condition Class

Table 319 through Table 321 display the fire regime condition class vegetation departure index values for the Dry upland forest by National Forest and across all alternatives projected over 50 years.

Table 319. Malheur National Forest fire regime condition class vegetation departure index (0 to 100) for the dry upland forest potential vegetation group

Timeframe	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. E-Mod.	Alt. E-Mod. Dep.	Alt. F
Existing Condition	62	62	62	62	62	62	62	62
Year 20	56	54	56	47	51	51	49	53
Year 50	48	46	50	34	38	37	36	43

Table 320. Umatilla National Forest fire regime condition class vegetation departure index (0 to 100) for the dry upland forest potential vegetation group

Timeframe	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. E-Mod.	Alt. E-Mod. Dep.	Alt. F
Existing Condition	60	60	60	60	60	60	60	60
Year 20	57	55	57	49	53	52	51	54
Year 50	48	47	52	40	41	40	40	44

Table 321. Wallowa-Whitman National Forest fire regime condition class vegetation departure index (0 to 100) for the dry upland forest potential vegetation group

Timeframe	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. E-Mod.	Alt. E-Mod. Dep.	Alt. F
Existing Condition	57	57	57	57	57	57	57	57
Year 20	58	56	57	50	52	52	51	54
Year 50	54	52	55	45	45	45	45	50

Dry Upland Forest Potential Vegetation Group – The dry upland forest makes up the vast majority of the Malheur's forest landscape and represents one-half or more of the Umatilla and Wallowa-Whitman National Forests. Within the dry upland forest potential vegetation group of these three National Forests, all of the alternatives would result in some reduction in the degree of vegetation departure over time, though these conditions would remain consistent with fire regime condition class 2. Alternatives D, E, E-Modified, and E-Modified Departure would be the most successful in terms of moving the forest vegetation toward low departure from our desired conditions. Most of the dry upland forest is naturally characterized under the high-frequency/low-severity Fire Regime I. These four alternatives would do the most to reduce the potential for uncharacteristic levels of high severity stand replacing fire within the dry upland forest due to reduction of mid-seral closed canopy stands, which currently are outside historic levels (Agee 2003 and 2005, Campbell 1996, Lehmkuhl 1994, Parsons 1979, Skinner 1995). The higher amount of harvest thinning, when combined with other fuels treatments and prescribed burning, would tend to out-perform Alternatives like C, which rely more heavily on natural unplanned wildfires to achieve objectives (Van Mantgem et al. 2016).

Alternative D is somewhat unique in that it would not include objectives for prescribed burning outside of harvest units, and it would look for decreased amounts of prescribed burning within harvest units. The approach of Alternative D would be to use mechanical treatments like mastication or removal as surrogates to wildland fire. However, the lack of wildland fire under Alternative D would inhibit other ecological processes. Alternative D would also limit the reapplication of fire to maintain stands that have previously have been burn with prescribed fire. Based on prescribed fire accomplishments over the last 15 years this could reduce needed burning by up to 10,000 acres a year.

One reason that even the alternatives with the most aggressive objectives for active management cannot return the dry upland forest to fire regime condition class 1 within 50 years is related to the lack of late seral open forests (see related "Old Forest" section in this chapter). For many areas that currently have an abundance of mid-aged 90 to 110 year old forests, it will take more than 50 years for those forests to grow into larger and older more fire-resistant trees. The proper functioning of the dry upland forest's natural low-severity surface fire regime is very dependent on the presence of these structural features.

Alternatives D, E, E-Modified, E-Modified Departure would result in relatively more reduction of stand density and more widespread restoration of natural fine scale patterns of dispersed clumps, dense patches and openings. These changes would create conditions more conducive to managing future unplanned wildfires as tools to achieve ecological objectives, rather than as unwanted incidents to be suppressed. These same low-density stand conditions would also facilitate the regeneration and development of more fire, drought, and disease resistant species, which tend to be intolerant of the shaded conditions found within high density stands.

Under Alternative C, the fire regime condition class vegetation departure index remains moderately high at approximately 50 to 55 through year 50. This represents the highest departure index value among all of the alternatives. Forest vegetation conditions of the dry upland forest would remain more highly departed from the historical range of variability under Alternative C due to the persistence of disproportionately large areas of high stand density, altered species compositions, and uncharacteristic stand structures. These unnatural forest vegetation conditions would not support the objective of allowing unplanned wildfires to return to their typical role within the dry upland forest ecosystem. The risk of loss of key ecosystem components, such as native species, large trees, and soil, would be greatest under Alternative C due to the persistence of an increased risk of uncharacteristically severe fire behavior.

Moist Upland Forest – Fire Regime Condition Class

Table 322 through Table 324 display the fire regime condition class vegetation departure index values for the moist upland forest by National Forest and across all alternatives projected over 50 years.

Table 322. Malheur National Forest fire regime condition class vegetation departure index (0 to 100) for the moist upland forest potential vegetation group

Timeframe	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. E-Mod.	Alt. E-Mod. Dep.	Alt. F
Existing Condition	37	37	37	37	37	37	37	37
Year 20	21	21	21	19	20	16	15	20
Year 50	19	17	18	8	11	10	8	13

Table 323. Umatilla National Forest fire regime condition class vegetation departure index (0 to 100) for the moist upland forest potential vegetation group

Timeframe	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. E-Mod.	Alt. E-Mod. Dep.	Alt. F
Existing Condition	27	27	27	27	27	27	27	27
Year 20	19	18	18	18	19	17	19	18
Year 50	18	17	17	15	13	14	12	14

Table 324. Wallowa-Whitman National Forest fire regime condition class vegetation departure index (0 to 100) for the moist upland forest potential vegetation group

Timeframe	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. E-Mod.	Alt. E-Mod. Dep.	Alt. F
Existing Condition	23	23	23	23	23	23	23	23
Year 20	24	23	23	21	22	22	21	22
Year 50	26	24	25	18	19	19	17	22

Moist Upland Forest Potential Vegetation Group – The moist upland forest makes up a very small portion of the Malheur's forest landscape and occupies a minority of the Umatilla and

Wallowa-Whitman National Forests. Across the moist upland forest potential vegetation group, all of the alternatives would successfully maintain the forest vegetation at a low-level departure condition over time. These low levels of departure from the historical range of variation would be consistent with forest vegetation in fire regime condition class 1. The natural fire regime for the moist upland forest is more nuanced and complex than the dry or cold upland forests. It is generally label as Fire Regime III, which is characterized by variable fire return intervals ranging from 35 to 150 years. Severity is typically mixed, with low, moderate and severe fire behavior all playing significant roles. Relatively modest levels of active management were scheduled within these cold upland forests, so the similar results across alternatives may be driven largely by the effects of natural stand development.

Cold Upland Forest – Fire Regime Condition Class

Table 325 through Table 327 display the fire regime condition class vegetation departure index values for the Cold upland forest by National Forest and across all alternatives projected over 50 years.

Table 325. Malheur National Forest fire regime condition class vegetation departure index (0 to 100) for the cold upland forest potential vegetation group

Timeframe	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. E- Mod.	Alt. E- Mod. Dep.	Alt. F
Existing Condition	54	54	54	54	54	54	54	54
Year 20	23	27	23	23	22	21	21	23
Year 50	7	8	8	19	18	5	6	12

Table 326. Umatilla National Forest fire regime condition class vegetation departure index (0-100) for the cold upland forest potential vegetation group

Timeframe	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. E- Mod.	Alt. E- Mod. Dep.	Alt. F
Existing Condition	13	13	13	13	13	13	13	13
Year 20	12	12	11	18	14	11	11	14
Year 50	10	11	11	24	16	10	10	13

Table 327. Wallowa-Whitman National Forest fire regime condition class vegetation departure index (zero-100) for the cold upland forest potential vegetation group

Timeframe	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. E- Mod.	Alt. E- Mod. Dep.	Alt. F
Existing Condition	38	38	38	38	38	38	38	38
Year 20	25	24	24	26	26	25	23	23
Year 50	12	12	12	18	15	13	11	11

Cold Upland Forest Potential Vegetation Group – The cold upland forest makes up a very small portion of the Malheur and Umatilla's forest landscape and occupies a minority of the Wallowa-Whitman National Forests. Within the cold upland forest potential vegetation group, all

of the alternatives would either successfully return the forest vegetation to a low-level departure condition or maintain those conditions. These low levels of departure from the historical range of variation would be consistent with vegetation in fire regime condition class 1. The natural fire regime for much of the cold upland forest would be characterized by relatively infrequent, high-severity fire. Relatively modest levels of active management were scheduled within these cold upland forests, so the similar results across alternatives may be driven largely by the effects of natural stand development.

Fire Severity Effects

All of the alternatives would have the potential to influence the number of acres of wildfire and the associated distribution of severity classes. The VDDT model as used is nonspatial, so no analysis of the effects of treatments on fire size was completed. In reality, the spatial location of treatment acres relative to landscape and vegetation patterns can influence the size of fires (Finney 2001, Reinhardt 2008). It is assumed that the actual treatments implemented would be strategically located to leverage the benefit that they would provide in managing towards the desired conditions for fire severities and frequencies. Vegetation types that consist of smaller diameter, dense, multi-storied, and thinner bark species (alpine fir, spruce) would have a higher probability of a mixed or high severity fire.

Fire return intervals are now much longer than those estimated to have occurred historically. These changes are most apparent in the dry upland forest potential vegetation group. Data indicates that the amount of fire has increased in the last 25-year period. Much of the fire that has occurred in the warm-dry systems has been high severity fire, as opposed to the low severity fires that historically dominated these areas (Dennison 2014, Hardy 2005, Williams 2013.

Fire severity data indicates that, under severe fire weather conditions, much of the area has the potential for high severity fire (based on CVS data and the forest vegetation simulator-fire/fuel extension modeling). The current potential for high severity fire within the cold and moist upland forest potential vegetation groups exhibits the least amount of departure from historical/reference values. Even though the cold and moist upland forest potential vegetation groups show the potential for a moderate to high amount of high severity fire (32 to 55 percent of each potential vegetation group), this amount of fire is consistent with the mixed to infrequent high severity fires that historically dominated these systems, however increased length of fire season due to climate change may bring this potential to the upper limits of the historic averages at 80 percent. Within the dry upland forest potential vegetation group, the potential for high severity fire ranges from approximately 50 to 55 percent, which indicates a moderate to high increase in high severity fires, compared to historical/reference conditions at 5 to 15 percent as shown in Table 315. This current increase in potential fire severity can increase loss of key ecosystem functions, especially with the potential for longer fire seasons with increased fire severity effects due to climate change.

Under all of the alternatives, the VDDT predicted acres burned in the fifth decade decreased slightly when comparing the acres burned in the second decade. The average acres burned (since 1980 to 2001, based on actual wildland fire history data) on National Forest System lands in the Blue Mountains was about 22,000 acres. With the model, the predicted acres burned increased to 25,000 acres per year in the second decade, and then decreased slightly to 16,000 acres per year. Based on updated analysis from 2001 to 2017 acres burned from wildfire have increased 25,000 acres per year.

Cold Upland Forest Potential Vegetation Group

Within the cold upland forest potential vegetation group, all of the alternatives would result in a high proportion of high severity fire through time within all three National Forests. This would be within the historical range of variability/desired condition range for the percent of high severity fire within the cold upland forest potential vegetation group. High severity fire is the historical fire regime within the cold upland forest potential vegetation group. Because only 5 to 10 percent of the harvest activities would occur within the cold upland forest potential vegetation group, fire severity would not be substantially altered as a result of the alternatives. All of the alternatives would utilize wildfire for resource benefits (unplanned ignitions) within the cold upland forest potential vegetation group. Long fire seasons do to climate change predictions may move fire return interval to the upper ranges of historic occurrences. See climate change section.

Moist Upland Forest Potential Vegetation Group

Within the moist upland forest potential vegetation group, Alternatives D and E would result in the closest achievement of the desired conditions based on historic fire regimes within all three National Forests. With removal of ladder and crown fuels the potential for high severity fire would be reduced the most under Alternatives D and E due to the increased levels of timber harvest activities, mechanical fuels treatments, and/or use of fire associated with these alternatives. The increased levels of harvesting activities under alternatives D and E would result in an increased percent of the landscape in open stand densities. Decreased stand densities result in decreased crown continuity, decreased fuel loadings, increased wind speeds required to initiate and sustain a crown fire, and decreased fire severity. Decreased stand densities would also result in regeneration of more shade intolerant/fire tolerant tree species. Although there would be substantial reductions in the potential for high severity fire under Alternatives D and E, mixed severity fire would maintain a role in the moist upland forest potential vegetation group. Mixed severity fire is the historical fire regime within the moist upland forest potential vegetation group.

Dry Upland Forest Potential Vegetation Group

Within the dry upland forest potential vegetation group within all three National Forests, Alternatives D and E would most closely achieve the desired conditions for fire severity within each of the three National Forests for those acres treated. Acres treated would range 1-3 percent of the forests per year, which is less than needed to move departure to condition class 1 for all the Dry Upland Potential Vegetation Group. The potential for high severity fire would be reduced the most under Alternatives D and E, and E Modified due to the increased levels of timber harvest activities, mechanical fuels treatments, and/or fire associated with these alternatives. The increased levels of harvesting activities under Alternatives D, E, and E modified would result in an increased percent of the landscape in open stand densities and would create a more open forest structure that more closely resembles the forest structure that existed prior to interruption of the historical frequent fire regime. A more open forest structure would result in decreased competition between trees for moisture, nutrients, and sunlight, increased tree health, growth, and vigor, decreased risk of insect attack and mortality, increased spatial heterogeneity, decreased crown continuity, decreased fuel loadings, increased wind speeds required to initiate and sustain a crown fire, and decreased fire severity. Decreased stand densities would also result in increased regeneration of more shade intolerant tree species and closer achievement of the desired conditions for species composition. Shade intolerant tree species such as ponderosa pine are better adapted to a frequent fire regime, better able to withstand low severity fire, and result in a lower fire hazard. Alternatives D and E would result in increased ecological resiliency in the dry upland forest potential vegetation group by decreasing fire severity across the landscape. The

increased percent of the landscape in open stand densities would also aid in the reintroduction of low severity surface fire into the ecosystem. Because Alternatives D and E would result in an increased number of acres of timber harvest activities and an increased percent of the landscape in open stand densities, there would be more opportunities to use wildfire for resource benefits, in comparison to Alternative C.

Within the dry upland forest potential vegetation group within all three National Forests, the potential for high severity fire would be highest under Alternative C due to the decreased levels of timber harvest activities associated with this alternative. Alternative C would result in an increased percent of the landscape in closed stand densities. Increased stand densities would result in increased crown continuity, increased fuel loading, decreased wind speeds required to initiate and sustain a crown fire, and increased fire severity. Increased stand densities would also result in regeneration of more shade tolerant/fire intolerant tree species. In theory, Alternative C would rely mainly on the use of fire (planned and unplanned ignitions) to reduce stand densities. Rather than harvesting trees to reduce tree densities, trees would be thinned by fire under Alternative C. However, due to the high percent of the landscape in closed stand densities and the potential for very high levels of mortality and high severity fire effects to other resources such as soils, the window or time frame under which fire could and would be managed to achieve the desired conditions for stand densities, structural stages, and species composition would be limited based on current conditions and the inability to reintroduce fire to meet low severity fire effects. Other alternatives use mechanical treatment to condition stands for reintroduction of fire, without modification of ladder fuels and crown fuels windows application of fire would be more restricted. Additionally, the levels of smoke emissions generated under Alternative C would be substantially increased, further limiting burn windows and the amount of acres that could be burned due to the increased levels of particulate matter generated. Impacts to public health from the likelihood of exceeding air quality standards would also substantially limit the amount of acres that could be burned under Alternative C. Alternative C would likely result in increased fire severity, decreased ecological resiliency, and loss of key ecosystem components and functions due to scope and scale of fire severity outside that which historically occurred within the dry upland forest potential vegetation group.

Cumulative Effects

Potential cumulative effects were analyzed by considering the effects of the alternatives in the context of past, present (ongoing), and reasonably foreseeable future activities that have occurred within the vegetation cumulative effects analysis area. This analysis area consists of the 25 sub basins (HUC 4) which contain the Malheur, Umatilla, and Wallowa-Whitman National Forests and other lands. The time period into the future considered was 50 years. The effects that past activities have had on forest vegetation are discussed in the “Forest Vegetation,” “Timber and Forest Products,” and in this section under the History and Affected Environments sections. Present and foreseeable future activities that could affect forest vegetation are summarized below.

Human Population Increases and/or Shifts toward Wildland-Urban Interface

For the last several decades, there has been more human development within the wildland-urban interface within the Pacific Northwest and specifically in rural Oregon a growth of 22 percent (Cohesive Strategy 2001). The trend indicates that people will continue to move to western states and build houses adjacent to National Forest System lands, resulting in additional areas designated as wildland-urban interfaces during the life of the Forest Plan. Adjacent ownerships and inholdings of private property can influence management options for fuels treatments and

prescribed fire. Human development within the wildland-urban interface has had effects on forest vegetation by influencing the locations of hazardous fuels reduction treatments. Implementing fuels reduction treatments within a wildland-urban interface may postpone or override the opportunity for vegetation treatments intended to meet other resource needs in areas located away from communities (Collins, Stephens, Moghaddas, and Battles 2010). Public support and concerns will also affect fire and fuels projects and may affect the use of fire by limiting fire in some areas because of social and political issues and smoke concerns. These trends are likely to continue in the future. Additionally, with a greater number of people living and recreating in the wildland-urban interface areas, there is a greater probability of more human-caused wildfire ignitions that could affect forest vegetation.

Community assistance plans that identify wildland-urban interface areas and opportunities for fuels treatments in areas adjacent to national forests would enhance the Forest Service's ability to treat these areas and protect high risk, high value areas. Community wildfire protection plans emphasize a collaborative approach to fuel reduction projects on both public and private land and place priority on treatment areas identified by communities themselves. These plans involve identifying fuel hazards, the risk of wildfire occurrence, structures and other community values at risk, and local preparedness capabilities. Community Wildfire Protection Plans would help to establish community priorities, recommendations, and develop an action plan and assessment strategy for communities at risk. Currently, all of the counties located within the cumulative effects analysis area have prepared Community Wildfire Protection Plans, including Baker, Umatilla, Grant, Harney, Morrow, Union, Wallowa, Asotin, Columbia, Garfield, Idaho, Nez Perce, Walla Walla, Adams, Wheeler, Washington, Crook, Malheur, Gillian, and Deschutes Counties. The ability to reduce fire hazard across agency boundaries and on private ownership contributes to long-term forest health, mitigation of large fires, reduction of suppression costs, and greater firefighter and public safety. The amount treated annually is difficult to predict due to a number of factors, but is predicted to increase.

Carbon Sequestration

Forests are an important part of the global carbon cycle as they help slow the rising of atmospheric carbon dioxide concentrations by storing carbon in forest biomass and soils, as well as in some forest products. Carbon fluxes between the atmosphere and forests are complex, and vary spatially and temporally. The Malheur, Umatilla, and Wallowa-Whitman National Forests store and sequester approximately 13 percent of the total Pacific Northwest Region carbon and carbon dioxide (Figure 41; data obtained from Heath et al. 2011). The Umatilla has the highest carbon levels of the three national forests, followed by the Malheur and the Wallowa-Whitman.

Factors that could potentially influence whether carbon stocks shift from regional carbon sinks to carbon sources include increasing temperatures, changes in precipitation, changing disturbance regimes (such as more frequent fires), and land use that decreases forested area. Carbon stocks are affected by disturbances such as wildfires, insect activity, timber harvesting, and weather events. USDA Forest Service 2015). How the complex interactions between climate, fire, and insect outbreaks will affect the carbon cycle within the Blue Mountains is challenging to quantify with any certainty because the science is still developing in this area.

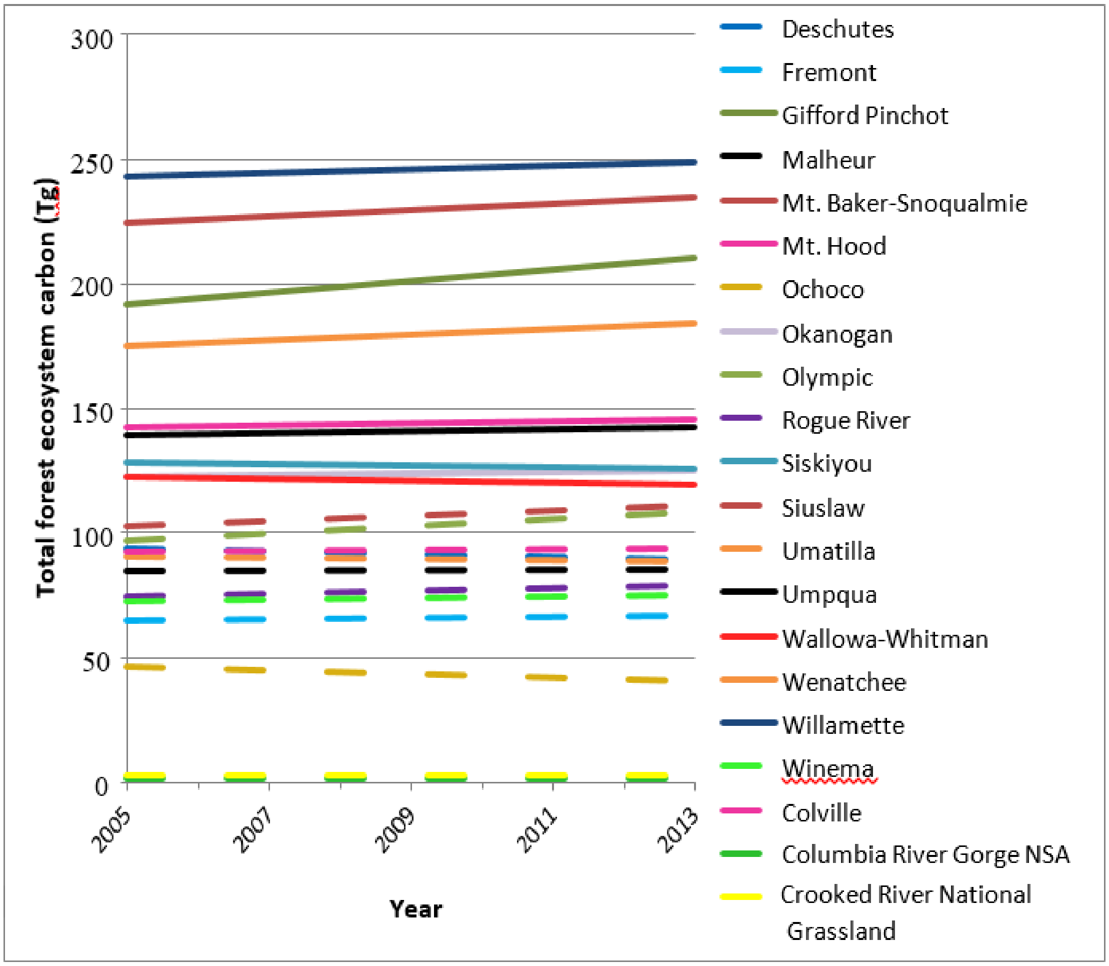

Figure 41. Total forest ecosystem carbon (Tg) for the national forests and grassland in the Pacific Northwest Region from 2005 to 2013 (USDA Forest Service 2015)

Under simulations, eastern Oregon gains ecosystem carbon as a result of the expansion of forest and woodland vegetation, while also experiencing more frequent and larger wildfires (Millar et al. 2006). This has implications for carbon sequestration as well as timber production. Timber productivity could increase through three mechanisms: through carbon dioxide fertilization, through warming in cold climates (which extends growing seasons where precipitation also increases), or through precipitation increases under currently water-limited conditions (Fischlin et al. 2007). However, the magnitude of these effects remains uncertain. Countering these potential increases in timber productivity are the effects of increased fire and insect disturbance.

Mitigation options that can help reduce climate change impacts on carbon include maximizing the forests' capacity to store carbon, decreasing carbon loss potential from disturbance, and utilizing biomass for energy. However, these options need to weigh tradeoffs and risks, and must ultimately be coupled with adaptation strategies. A forest's carbon capacity could be maximized by retaining large diameter trees or by extending rotation age (AFE 2009). Carbon loss potential from disturbance could be decreased through fuels reduction treatments that decrease fire severity and increase ecological resiliency. Forest management practices that maintain and increase forest area, reduce natural disturbances in the forest, improve forest conditions, and ensure the

appropriate and timely transfer of carbon into wood products lead to increasing overall carbon storage (Liu, Han 2009)

Timber management projects can influence carbon dioxide sequestration in three main ways: (1) by increasing new forests (afforestation), (2) by avoiding damage or destruction of forests (avoided deforestation), and (3) by manipulating existing forest cover (managed forests). Land-use changes, specifically deforestation and regrowth, are by far the biggest factors on a global scale in forests' role as sources or sinks of carbon dioxide, respectively (IPCC, Intergovernmental Panel on Climate Change, 2000). Projects that create forests or improve forest conditions and capacity to grow trees tend to increase carbon sequestration. Research by Hurteau and North (2009) found that, in wildfire-prone forests, tree-based carbon stocks were best protected by fuel treatments that produced a low-density stand structure dominated by large, fire-resistant pines. However, other findings suggest that reducing the fraction by which carbon is lost in a wildfire requires the removal of a much greater amount of carbon, since most of the carbon stored in forest biomass remains unconsumed even by high-severity wildfires (Mitchell et al. 2009). Most of the treatments simulated resulted in a reduced mean stand carbon storage.

Climate Change Influences

Of all of the ongoing and foreseeable future actions that have the potential to affect forest vegetation within the Blue Mountains, climate change potentially may be the most important factor. The effects of climate change may combine with some of the effects that result from implementing the alternatives to produce cumulative effects. Although increases in temperature, changes in precipitation, higher atmospheric concentrations of carbon dioxide, and higher nitrogen deposition may change ecosystem structure and function by the end of the 21st century, the most rapidly visible and most significant short-term effects on forest ecosystems may be caused by altered disturbance regimes (Vose et al. 2012). In general, given the existing condition of the forest vegetation within the Blue Mountains, the potential effects (and uncertainties) that climate change may have on forest vegetation can be summarized as follows (CCVA Halofsky et al. 2017):

- The importance of pine and sagebrush species may increase.
- The forest-steppe ecotone may move north of its present position or up in elevation.
- Ponderosa pine may be found at higher elevations.
- Subalpine and alpine systems are potentially vulnerable, and subalpine tree species may be replaced by high-elevation grasslands, pine, or Douglas-fir.
- Juniper woodlands, which have been increasing in recent decades, may be reduced if longer and drier summers lead to more wildfire.
- Grasslands and shrublands at lower elevations may increase across the landscape but shift in dominance towards more drought-tolerant species.
- Nonnative species, including annual grasses, may increase in abundance and extent.

In the future, climate change is anticipated to contribute to the character of the Blue Mountains forests, disturbance regimes, and timber productivity (Schmoldt et al. 1999). At the most fundamental level, plant physiology may change in response to increased temperatures and carbon dioxide concentrations, in some cases reducing transpiration and water loss. The potential for carbon dioxide-induced increases in plant water use efficiency are not well known. There is a potential for increased forest growth in areas that become warmer and wetter, and decreased

growth in areas that become warmer and dryer (Fischlin et al. 2007). Where forest growth increases, there could be an accompanying increase in water demand because of higher evapotranspiration rates resulting from increased temperatures.

Climate change, primarily through increases in temperatures and carbon dioxide and changes in precipitation, could result in shifts in species composition and distributions of forest communities. Climate changes have, and could continue to, result in earlier initiation of the growing season, longer growing season length, earlier plant senescence, and mismatches between climate characteristics and plant phenology. Plant species respond individually to changes in temperature and precipitation regimes, atmospheric carbon dioxide, and disturbance regimes. Hence, new plant associations may develop in the future as a result of climate change. More broadly, in future vegetation simulations produced by Bachelet et al. (2001a), areas of subalpine forest and alpine tundra in the Pacific Northwest are projected to decrease as temperatures increase at higher elevations (Bachelet et al. 2001b, Shafer et al. 2010). They also project an expansion of forest and woodland into areas of eastern Oregon currently dominated by grassland and shrubland as a result of projected increases in precipitation, a longer growing season, and increased plant water-use efficiency produced by increased atmospheric carbon dioxide concentrations. General increases in precipitation could result in expansion of woody species and shifts from grasslands to shrublands, or from grasslands and shrublands to woodlands and forests. Conversely, decreases in effective precipitation could cause declines in vegetation productivity and shifts from forests, woodlands, and shrublands to grasslands and deserts. Some species have the potential to expand upslope with increases in temperature. Some native forest species may be displaced where climate change favors invasive species. Changes in forest composition, structure, seasonality and productivity could have consequences for wildlife species dependent on forested habitats.

Inadequate water availability coupled with drying conditions could contribute to an overall increase in the vulnerability of forests to insects, fire, and drought. Recent forest dieback in the western United States, and model simulations, indicate that the frequency and magnitude of some disturbance events (e.g., drought, wildfire, and insect outbreaks) may be changing (Allen et al. 2010). The relative influence of climate and fuels on fire behavior and effects varies regionally and subregionally across the western United States (McKenzie 2004). However, an increase in fire activity is expected for all major forest types in the Blue Mountains under projected climate changes (Bachelet et al. 2001, Whitlock et al. 2003, Keeton et al. 2007). A warmer climate has already led to more frequent fires, more severe fires, earlier initiation of the fire season, and a longer fire season in the western United States (Westerling et al. 2006). Littel et al. (2009) built statistical models of the associations between seasonal and annual precipitation, and temperature and fire extent for 1916-2002 for the 11 contiguous western states. They found that relatively modest changes in mean climate will lead to substantial increases in area burned, particularly in crown-fire ecosystems in which distinct thresholds of fuel moisture and fire weather exist (Littel 2009). For a mean temperature increase of 4 degrees Fahrenheit (expected by the mid-21st century), annual area burned by wildfire is expected to increase by a factor of 1.5 to 5. Summer temperature forces the change in area burned, likely as a result of overall drought patterns and fuel dryness. Large fires (greater than 1,000 acres) account for most of the area burned in the Blue Mountains in a given year. Regional-level relationships between climate and fire differ, depending on seasonal and annual variability in climatic drivers, fire frequency and severity, and the legacy of previous-year climate in live and dead fuels (Spies 2010,Veblen et al. 2000, Hessl 2004). Current-year drought is typically associated with more area burned, but the effects of antecedent conditions differ owing to interactions among climatic effects (Littel 2009). In the Pacific Northwest, direct associations exist between fire extent and current-year drought (Hessl

2004, Wright and Agee 2004, Heyerdahl et al. 2001, Heyerdahl et al. 2008). In the cold upland forest potential vegetation group and some moist upland forest potential vegetation groups where fine fuel production is not limited by climatic variability, short-term synoptic fluctuations in atmospheric conditions play an important role in forcing extreme wildfire years (Johnson 1993, Gedalof et al. 2005).

In general, there is a greater range of area burned under hot, dry conditions than under cool, wet conditions. Whereas cool, wet conditions nearly always lead to reductions in area burned, favorable fire conditions do not necessarily lead to increases in area burned. Factors such as ignition source, location, fire suppression, and resource availability greatly influence fire size. As long as weather conditions continue to be favorable for wildfire, forests will remain flammable and ignition and rapid spread could occur at any point during the fire season. It remains to be seen how increases in conditions favorable for wildfire could impact the ability to use prescribed burning as a management tool.

Insect lifecycles depend on a complex interaction of temperature, moisture, and suitable hosts. Although outbreak dynamics differ from species to species and from forest to forest, climate change appears to be one driving factor for some of the current forest insect outbreaks in western North America. Temperature influences everything in an insect's life, from the number of eggs laid by a single female, to the insects' ability to disperse to new hosts, to individuals' over-winter survival and developmental timing. Elevated temperatures associated with climate change, particularly when there are consecutive warm years, can speed up reproductive cycles and reduce cold-induced insect mortality. Additionally, shifts in precipitation patterns and associated drought can also influence insect outbreak dynamics by weakening trees and making them more susceptible to attacks. For many forest insect species (primarily beetles; notably *Ips* and *Dendroctonus* species), the influence of elevated temperatures on outbreak dynamics is most notable at higher elevations and latitudes where some beetles have shifted to completing their development in a single year, rather than two or even three years or, in some cases, have shifted to completing multiple generations per year. Halofsky and Peterson (2017) state:

> Critical thresholds in ecosystem structure and function may be exceeded in a warmer climate. Warmer temperatures may increase the potential for insect and disease outbreaks, particularly as a transient response in colder temperate zones where insect and pathogen vigor has been limited by suboptimal temperatures (Bentz et al. 2010). Higher warm-season temperatures should also increase growth rates for temperate insect herbivores, although the rate of increase will vary by species (Bale et al. 2002). For some species, faster growth rates and reduced development time could enhance juvenile survivorship by reducing predation rates during the larval and nymphal feeding stages (Bernays 1997, cited by Bale et al. 2002).

All else remaining constant, this decrease in generation time translates to an increasing rate of population growth.

Depending on the magnitude of the temperature increase, which may vary by elevation, high elevation forests could be at greater risk to insect infestation than lower elevation forests, where warmer temperatures may disrupt the insects' seasonality. Elevated winter temperatures are associated with increased winter survival; however, it should be noted that increased winter survival does not always coincide with increased population success based on developmental timing. Each process is affected by temperature patterns occurring at different times of the year.

The combined expectations regarding increases in water limitation, wildfire activity, high elevation adaptive mountain pine beetle seasonality, and forest vulnerability to drought, fire and

insects, suggest that Blue Mountains forests are likely to be fundamentally affected by altered disturbance regimes as the region's climate changes (Halofsky and Peterson 2017).

Fire Regime Condition Class

The emphasis on treatments of fire regime condition class 2 and 3 would continue. This is applicable to Bureau of Land Management, State lands, and National Forest System lands. In general, private lands are dominated by condition class 2 and 3 due to deviations from historic fire return intervals in part due to land owner liability in using fire on private lands.

Wildfire and Other Disturbance Mechanisms

Most of the vegetation types in the analysis area have evolved with fire. Fire frequency and intensity varied historically by vegetation type, and vast acres of shrub and timber burned each year (Agee 1993, Johnston 2016, Heyerdahl 1996). There is evidence that Native Americans used fire to herd game and provide feed for stock. According to fire records, in the first half of the 20th century an average of 30 million acres burned each decade in the west.[8] Before that, settlers report seeing vast acreages of blackened land (Gruell 1985). With the settlement of the west came the notion that fires were bad (Pyne 2008). Following the fires of 1910, the Forest Service began its campaign to suppress wildfires. Instead of fire, settlers employed plows, railroads, saw blades, sluice boxes, cattle, sheep, and other accoutrements as disturbance agents. Settlers converted many acres of rangelands to farm ground, primarily in the lower elevations, while ranchers grazed horses, cattle and sheep on less productive and higher elevation sites. At the turn of the last century, livestock grazing occurred throughout the forest, introducing a new disturbance on what would later become National Forest System lands. High levels of livestock grazing reduced the fine fuels (grasses and shrubs) that carried low severity surface fires, resulting in a substantial reduction in fire disturbances on National Forest System lands (Hessburg 2005) .

Timber harvest replaced fire as the major disturbance on the national forest, but it did not affect an equivalent number of acres. This has led to a decrease in forests of older age classes and an increase in some areas of dense forests of smaller diameter classes. This change in age and size classes has resulted in conditions that are less resilient than desired.

Uncharacteristically severe wildfires are on the rise, especially in the dry upland forest potential vegetation group Dennison et al. 2014). Over the past 10 years, lightning-caused fires ranged from approximately 808 to 2,170 per year in the northwest. Human-caused fires ranged from approximately 1,078 to 2,666 fires per year in the northwest.[9] More fires are occurring adjacent to residential areas as people build more subdivisions and structures along public land boundaries. These changes are occurring across the west. A warmer climate will cause an increase in the frequency and extent of wildfire in most dry forest and shrubland ecosystems (Westerling et al. 2006, 2011). By around 2050, the annual area burned in most of the Western United States is projected to be at least two to three times higher than it is today (Littell et al. 2010; Littell, n.d., cited in Ojima et al.2014; McKenzie et al. 2004). The Blue Mountains ecoprovince is also expected to experience increased area burn by the mid-21st century. Recent research shows that the occurrence of large fires in the western United States has increased since around 1980 (Dennison et al. 2014). Many dry forests that have not burned for several decades have high fuel accumulations, and initial fires may cause uncharacteristic tree mortality compared to low levels

[8] http://www.nifc.gov/fire_info.html
[9] http://www.nifc.gov/fireInfo/fireInfo_stats_lightng.html

of mature tree mortality associated with historical surface-fire regime "(Halofsky and Peterson 2017).

Most of the higher elevation cold upland forest potential vegetation group in the cumulative effects area is located in National Forest System lands. Therefore, management activities affecting these vegetation types would be initiated by the Forest Service. Much of the cold upland forest potential vegetation group is located within existing or proposed wilderness, roadless, or backcountry areas. Under all of the alternatives, only approximately 5 to 10 percent of the harvest activities in Forest Service System lands would occur within the cold upland forest potential vegetation groups. The majority of vegetation effects resulting from management actions within the cold forest potential vegetation group would occur as the result of wildfire managed for resource benefits. The cold upland forest potential vegetation group was historically characterized by infrequent, high severity fire. Any fire, planned or unplanned, could result in stand-replacing events with high levels of mortality. If climate change causes fires to increase in size and severity, managing wildfires for resource benefits to achieve desired conditions may become more difficult. Over the life of any fire, many strategies could be implemented based on safety, values at risk, suppression cost, suppression resource availability, and the consistency of predicted fire effects with the desired conditions.

Within the dry upland forest potential vegetation group, existing vegetation conditions tend to be more highly departed from the historical range of variability due to the historic, frequent fire regime and a greater number of missed fires. All of the alternatives would attempt to address, to varying amounts, some of the negative effects of the past events that have occurred within the dry upland forest potential vegetation group within the cumulative effects analysis area. Under Alternatives E-Modified, D and E, the dry upland forest potential vegetation group would be expected to exhibit decreased fire-related mortality due to more open stand densities resulting from increased levels of timber harvest activities. Approximately 60 to 90 percent of the mechanical treatments would occur within the dry upland forest potential vegetation group. Under Alternative D, approximately 72 to 77 percent of Forest Service lands within the cumulative effects analysis area would contain open stand densities at year 50. Under Alternative E, approximately 69 to 70 percent of Forest Service lands within the cumulative effects analysis area would contain open stand densities at year 50. Under Alternative E Modified, approximately 69 to 75 percent of cumulative effects analysis area would contain open stand densities at year 50. Under these alternatives, the majority of the landscape would be fairly open. Conditions would be conducive to the reintroduction of low severity fire. There would be more opportunities to use prescribed fire and to manage unplanned ignitions for resource benefits to achieve desired conditions.

Decreased stand densities would also result in regeneration of more shade intolerant/fire tolerant tree species. Within the dry forest potential vegetation group, it would be beneficial to increase the percent of the landscape in shade intolerant/fire tolerant species because this would result in decreased fire behavior and decreased risk of uncharacteristically severe wildfire across the cumulative effects area. This would also result in decreased fire risk to adjacent land ownerships. If climate warms over time and fires increase in size and severity, a landscape dominated by more open stand conditions with shade intolerant/fire tolerant tree species would be at decreased risk for catastrophic, uncharacteristically severe wildfire and more sustainable and ecologically resilient.

Difficulties may arise due to the mixture of land ownerships that occurs within the lower elevation, dry upland forest potential vegetation group within the cumulative effects analysis area.

Other ownerships adjacent to or surrounded by lands administered by the Forest Service affect opportunities to use fire and, therefore, to emulate historical fire effects on large landscapes. In general, private landowners use timber harvest rather than fire to manage their vegetation. Fire may be used to treat activity fuels, but treatments are often limited in extent and effect. The proximity or inclusion of private lands affects, in particular, the use of fire because these fires can burn large areas for long time periods depending on the vegetation, fuels, weather, and other factors. However, fire management activities can be coordinated with managers of adjacent public lands, such as the Bureau of Land Management and adjacent national forests, or other agencies. In this case, effects of managing wildfire could extend beyond lands administered by the Forest Service.

Restoration activities occurring within the dry upland forest potential vegetation group would most likely occur in National Forest System lands, although current grant opportunities exist for restoration treatments on private non-industrial lands (Joint Chiefs USDA 2014, Nature Conservancy TREX Program) Restoration activities, such as prescribed burning or managing for old forest, would be beneficial to the overall functioning of these ecosystems and would improve wildlife habitat within these vegetation types. Some vegetation components may take many years before noticeable changes occur on the landscape. Other more localized changes would be dramatic and immediate. For example, removing large trees affects not only size class distributions of forest stands, but also the recruitment of snags over time and would reduce the density of large snags on a landscape basis. Given the existing conditions, large tree removal on or off National Forest System lands would affect distribution of the large tree component and future snags and coarse woody debris at a landscape scale. Therefore, the retention and future development of these critical components on National Forest System lands would be essential to providing habitat elements needed by many species. Improvements to these components would cumulatively affect and improve the conditions within the lower-elevation ponderosa pine, dry upland forest potential vegetation groups. Disturbances such as fire, insects, disease, and windthrow would migrate across a landscape, depending upon conditions, and may move from National Forest System lands to other ownerships or vice versa. Vegetative conditions would have a substantial influence on the spread, extent, and direction of disturbances.

All of the proposed forest vegetation treatments would reduce stand density and thereby reduce risks from bark beetles for a 15- to 25-year period. These vegetation treatments and prescribed fire would enhance ponderosa pine and western larch; however, prescribed fire would increase the risk of bark beetle attack in the short-term (1 to 3 years) because bark beetles are attracted to fire-killed and fire-damaged trees which would occur as a result of prescribed fire. In the long term, tree mortality from prescribed fire and associated insect infestations would work together to reduce stand density and reduce the risk of bark beetle infestation for 15 to 25 years. The reduced density of conifers would extend the opportunity for seedling ingrowths and herb/shrub-component enhancement, which would increase structural complexity and species diversity. Complexity and diversity are important in maintaining long-term site productivity (Franklin et al. 1989).

The forest vegetation treatments would reduce density to a prescribed level on a somewhat consistent basis across the treatment areas. Forest vegetation treatments would offer more control in achieving desired structural relationships than prescribed fire, whose affects are more random and less controlled. In the long term, where species that are more fire-resistant occur, lower stand densities would foster the use of prescribed fire to manage fuel loadings Van Mantgen 2016, Hessburg 2006. Prescribed fire reduces tree density on a more random and mosaic basis depending on fuel distribution, resulting in variations in fire intensity and tree mortality. All of the

proposed forest vegetation treatments and prescribed fire would reduce overall fuel loadings, increase average stand diameter, favor thicker-barked, self-pruning, early-seral species, and make the areas slightly less prone to uncharacteristic effects from wildfire. Such treatments are needed for restoration of landscape structure and fuel conditions. Hahn and others, in An Assessment of Ecosystem Components in the Interior Columbia Basin (Quigley and Arbelbide 1997), report that "without restoration of landscape structure and fuel conditions, the probability of returning to the succession/disturbance regimes that existed historically (that is, the native system) was determined to be low."

Terrestrial Wildlife Species

This section describes the affected environment, existing conditions, and environmental consequences of the alternatives on a variety of terrestrial wildlife species. The majority of effects to wildlife would result from the proposed management of other resources, such as wood fiber, motorized access, wildland fire, and livestock grazing. The projected impacts to wildlife from various management actions are described in this section, but the actual activities are discussed in more detail in their respective sections. Although the life of a forest plan is 10 to 20 years, impacts to wildlife are displayed on a decadal basis out to 50 years to clearly depict the trajectory for the element being discussed. Different levels of management are proposed for each of the alternatives, and each is described in detail in Chapter 2 and Appendix A. Unless otherwise noted, the description of effects is only for National Forest System lands in the Blue Mountains (excluding Hells Canyon National Recreation Area), and therefore references to the Plan Area, analysis area, or national forest are to public lands administered by the Forest Service, unless specifically noted otherwise.

Changes Made Between the Draft and Final Environmental Impact Statements

Aside from the global changes throughout this environmental impact statement described in the Preface to this document (see Volume 1), the following changes were made specifically to this section:

Changes in Species Classification Labels: Some terminology has been changed between the Draft and Final Environmental Impact Statements to reduce confusion and provide updates based on best available scientific information. The Draft Environmental Impact Statement referred to "species of conservation concern," which has a specific definition and process for selection under the 2012 Planning Rule that is not applicable to the plans revised under the 1982 Planning Rule. To avoid confusion with the 2012 Planning Rule and its implementing regulations, "species of conservation concern" is not used in this Final Environmental Impact Statement. See the Preface of Volume 1 for more information and the species category definitions in the "Regulatory Framework" section on page 228.

Changes to Elk Habitat and Security: Elk habitat and elk security within National Forest System lands has been more clearly defined in Alternatives E-Modified and E-Modified Departure to account for wildlife corridors that were removed in both of those alternatives, as well as now having objectives for moving toward improving both conditions.

Terrestrial Wildlife Species – Affected Environment

The conservation of wildlife species is integral to the maintenance of viable plant and animal populations and biological diversity. National Forest System lands administered by the Forest Service in the Blue Mountains have long served an important role in supporting a variety of wildlife species that are critical to the needs and values of the human population. The diversity of Blue Mountains wildlife habitat is outstanding as a result of the abrupt changes in vegetation that result from changes in aspect, elevation, temperature, moisture, geology, soil depth, the effects of fire, and the management activities and influence of humans. More than 300 wildlife species occur in the Blue Mountains (Baydeck 1999, Thomas 1979), many of which are migratory birds that occur here seasonally.

Federal land management agencies and the state wildlife agencies share legal co-trustee responsibility for the protection and management of wildlife. The Forest Service continues to work closely and cooperatively with both the Oregon Department of Fish and Wildlife (ODFW) and Washington Department of Fish and Wildlife (WDFW) for the conservation and management of wildlife resources, including habitat, within the Malheur, Umatilla, and Wallowa-Whitman National Forests. Such cooperation is important to meet the needs of a growing human population that places increasing demands and competing values on resources, which ultimately impact the wildlife resource.

Managing ecosystems to sustain terrestrial wildlife species depends on maintaining the appropriate mix of habitat quantity, quality, and distribution across the landscape. Most habitats for terrestrial wildlife species are shaped by vegetation characteristics, although in some cases it is an individual component, such as snags or talus slopes. Landscapes are diverse, highly complex systems influenced by many factors, including the interaction of soils, aspect, elevation, climate, disturbance events, and humans. Together these influences have shaped vegetative composition and patterns that have influenced the distribution and quality of wildlife habitats across the landscape (Hessburg et al. 1999).

Fire has historically been a dominant influence in the Blue Mountains (Agee 1993). Fire, insects, storms, disease, animals, and plant succession have been the agents most responsible for modification of habitat and altering species' habitat use (Hessburg et al. 1994, Heyerdahl et al. 2001). Over time, ecosystem conditions fluctuate within some range of variability related to the type and intensity of disturbances that occur. The term historical range of variability has been used to describe these fluctuations in ecosystems, using conditions prior to Euro-American settlement as a reference point (Morgan 2004). Historically, low-elevation forests in the Blue Mountains burned frequently (every few years) with low-intensity ground fires, leaving most of the large trees alive. In contrast, high-elevation forests usually burned with stand-replacing fires that killed most trees but at infrequent intervals (hundreds of years).

The categories and types of wildlife species within the Plan Area reflect the diversity of available habitat. Some species, such as mule deer and Rocky Mountain elk, are steeped in local culture and tradition and have long been important to the local people and communities. However, many nongame species have recently gained more recognition for the economic, aesthetic, and ecological values they provide. For example, as a resource, resident and migratory bird species in the United States generate more than 85 billion dollars in overall economic output and are enjoyed by more than 46 million people (USFWS 2003); however, they are more recognized for the ecological values they offer in terms of insect control, pollination, and seed dispersal. Some of the wildlife species that occur within the Plan Area are migratory and/or wide ranging and can

utilize several habitat types, while others are more sedentary and utilize only a single habitat or individual component within a habitat type.

Changes in vegetation due to natural and human-caused disturbance have affected terrestrial wildlife species and their habitat within the Blue Mountains national forests. For example, early timber and fire management strategies within dry forests have resulted in an ecosystem that is highly departed from what occurred historically. This leads to concern for the viability of some species, such as the white-headed woodpecker, that rely heavily on this ecosystem. Spatial characteristics of wildlife habitat, such as patch size and distribution, connectivity, and fragmentation, are largely determined by management actions and interactions with fire, insects, disease, and other natural disturbances. The extent of human influence within habitats can affect patch quality and connectivity and thereby affect wildlife presence and movement across the landscape. An example would be the I-84 corridor, which may impede the movement of some wildlife species between preferred habitats.

Within the Plan Area, major vegetation types that provide habitat for wildlife species have been described by various authors (Hall 1973, Hann et al. 1997, Johnson and Clausnitzer 1992, Johnson and O'Neil 2001, Thomas et al. 1979). Following procedures found in Powell et al. (2007), Countryman (2009) classified 60 plant association groups into 22 potential vegetation groups (see "Forest Vegetation," Timber and Forest Products," and "Wildland Fire" sections). Assessments of the Plan Area have been conducted to establish existing conditions (Countryman 2008, Countryman 2008a, Countryman and Justice 2010) and to compare to what is considered historical range of variability (Countryman and Swanson 2008 (revised 2010), Countryman and Justice 2010, Mason and Countryman 2010). In general, changes to vegetation types have been most significant in the lower elevations and least significant in the higher elevations, and past timber harvest has influenced many vegetation types and associated wildlife habitats. Some changes in ecological function have occurred as a result of these changes. Change in ecological function helps identify where the potential for active restoration is often higher, such as in ponderosa pine, and where the potential is lower, such as in higher elevation spruce-fir and alpine tundra types where deviation from historical conditions is less. Approximately 31 percent of the Plan Area is in inventoried roadless areas, designated wilderness areas, or other specially designated areas that contain representative vegetation types (Countryman 2009a). Inventoried roadless and wilderness area qualities offer large areas of wildlife habitat that are relatively undisturbed by humans and are especially important for some wildlife species.

Recent habitat assessments of landscape conditions and trends on lands administered by the Forest Service within the Blue Mountains have identified several major factors influencing change in forested and nonforested habitat conditions that have occurred since early Euro-American settlement (Countryman and Justice 2010, Countryman and Swanson 2008 (revised 2010), Mason and Countryman 2010, Quigley and Arbelbide 1997, Wisdom et al. 2000, Wissmar et al. 1994). Depending upon the vegetation type examined, these factors include fire exclusion, timber harvest, road and urban development, livestock grazing, and recreational uses associated with a rapidly growing human population, resulting in changed conditions and trends with implications for wildlife species that include:

- Changes in forest structure and composition that may contribute to uncharacteristic wildfire behavior in lower elevation forest types.
- Roads that fragment habitat and cause disturbance, with densities varying from about 14 miles per square mile to about 0.3 mile per square mile.

- Competition from invasive plant species that compromises plant diversity and habitat quality and connectivity.
- A reduction or degradation of habitats for some wildlife and plant species where human impacts have occurred, and/or where natural disturbance regimes have been altered.
- Urban development and infringement into some traditionally important wildlife habitats (including big game winter range), typically at lower to moderate elevations.
- A rapidly increasing human population that places uses and demands upon the landscape that alter habitat security and cause disturbance to wildlife species.

Regulatory Framework

The three principle laws relevant to wildlife management are the National Forest Management Act of 1976 (NFMA), the Endangered Species Act of 1973 (ESA), and the Migratory Bird Treaty Act (MBTA) of 1918 (as amended). In addition, the Forest Service Manual directs the Regional Forester to identify sensitive species for which viability may be a concern on each National Forest (FSM 2670.32). To comply with the previously mentioned laws and regulations, the following groups of species were considered in this forest planning process:

- **Forest Service Sensitive Species** – These are species of concern in the Blue Mountains from the 2011 Regional Forester's Sensitive Species List. Administrative direction exists to maintain or improve conditions for sensitive species as addressed in Forest Service Manual 2670. Currently, 33 terrestrial species identified by the regional forester as sensitive either occur or have habitat within the Plan Area.
- **Management Indicator Species –** The Blue Mountain Forest Plan Revision process used management indicator species for the purpose of assessing the impacts of the alternatives on wildlife and fish populations as directed in the 1982 Planning Rule (CFR 219.19 (a)(1) and (2)). The no-action alternative (no change in current management) was evaluated in terms of the management indicator species listed in the 1990 Forest Plans. New management indicator species were selected and analyzed for the plan revision alternatives.
- **Focal Species** – Species required by the 2012 planning rule for monitoring purposes. Although this plan revision was developed under the 1982 Planning Rule, it is required that the plan include a monitoring strategy that addresses the status of focal species as directed in the 2012 Planning Rule (36 CFR 219.12 (c)(1)).
- **Migratory Birds** – The migratory bird treaty act established an international framework for the protection and conservation of migratory birds. This Act makes it illegal, unless permitted by regulations, to "pursue, hunt, take, capture, purchase, deliver for shipment, ship, cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird."
- **Threatened and Endangered Species –** Species listed or proposed for listing under the Endangered Species Act. The Act requires the Forest Service to manage for the recovery of threatened and endangered species and the ecosystems upon which they depend. Forests are required to consult with the U.S. Fish and Wildlife Service if a proposed activity may affect the population or habitat of a listed species. The Forest Service Manual (FSM) direction provides additional guidance: identify and prescribe measures to prevent adverse modifications or destruction of critical habitat and other habitats essential for the conservation of endangered, threatened and proposed species (FSM 2670.31 (6)).

- **Surrogate Species** – The implementing regulations (36 CFR 219.19) for the National Forest Management Act of 1976 call for providing viable populations of native and desired nonnative vertebrates. Rather than evaluating the viability of each individual species within the Plan Area, a representative (surrogate species) was selected to represent a group of species. The surrogate species approach is a credible and scientifically rigorous method to assess ecosystem conditions that contribute to the viability of wildlife species. It is important to note that surrogate species were referred to as focal species in the Draft Environmental Impact Statement but the name was changed to avoid confusion with focal species as defined in the monitoring requirements of the 2012 Planning Rule.

Species can fall within one or more of the groups defined above (Table 328). For example, the white-headed woodpecker is a region 6 sensitive species, a management indicator species, a focal species, and a surrogate species that represents dry forest with medium/large trees. Two of the focal species, Rocky Mountain elk and mule deer, are not included in the table because they do not have population viability concerns.

Table 328. List and status of species analyzed in this forest planning process

Common Name	Surrogate Species	Federally Listed	Sensitive	Management Indicator Species	Focal
Gray-crowned rosy-finch	Yes	No	Yes (Oregon)	No	No
Black Rosy Finch	No	No	Yes (Oregon)	No	No
Spruce grouse	No	No	No	No	No
Boreal owl	Yes	No	No	No	No
Pine grosbeak	No	No	No	No	No
Water vole	Yes	No	No	No	No
Canada lynx	No	Yes (threatened)	No	No	No
Moose	No	No	No	No	No
Northern goshawk	Yes	No	No	Yes	No
Blue grouse	No	No	No	No	No
Great gray owl	No	No	Yes (Washington)	No	No
Long-eared owl	No	No	No	No	No
Sharp-shinned hawk	No	No	No	No	No
Rufous hummingbird	No	No	No	No	No
Williamson's sapsucker	No	No	No	No	No
Hammond's flycatcher	No	No	No	No	No
Cordilleran flycatcher	No	No	No	No	No
Mountain chickadee	No	No	No	No	No
Yellow-rumped warbler	No	No	No	No	No
Cassin's finch	Yes	No	No	No	No
Long-legged myotis	No	No	No	No	No
Silver-haired bat	No	No	No	No	No
Hoary bat	No	No	No	No	No
Northern flying squirrel	No	No	No	No	No
Vaux's swift	No	No	No	No	No
Pileated woodpecker	Yes	No	No	Yes	Yes
Chestnut-backed chickadee	No	No	No	No	No
Brown creeper	No	No	No	No	No

Common Name	Surrogate Species	Federally Listed	Sensitive	Management Indicator Species	Focal
Winter wren	No	No	No	No	No
Golden-crowned kinglet	No	No	No	No	No
Ruby-crowned kinglet	No	No	No	No	No
Townsend's warbler	No	No	No	No	No
Varied thrush	No	No	No	No	No
American marten	Yes	No	No	Yes	No
Fisher	No	No	No	No	No
Flammulated owl	No	No	No	No	No
White-headed woodpecker	Yes	No	Yes (both states)	Yes	Yes
White-breasted nuthatch	No	No	No	No	No
Pygmy nuthatch	No	No	No	No	No
Rubber boa	No	No	No	No	No
Calliope hummingbird	No	No	No	No	No
Dusky flycatcher	No	No	No	No	No
Western bluebird	Yes	No	No	No	No
Chipping sparrow	No	No	No	No	No
Dark-eyed junco	No	No	No	No	No
Purple finch	No	No	No	No	No
Pine siskin	No	No	No	No	No
California myotis	No	No	No	No	No
Fringed myotis	Yes	No	Yes (Oregon)	No	No
Long-eared myotis	No	No	No	No	No
Fox sparrow	Yes	No	No	No	No
Lazuli bunting	No	No	No	No	No
Upland sandpiper	Yes	No	Yes (Oregon)	No	No
American kestrel	No	No	No	No	No
Lewis's woodpecker	Yes	No	Yes (both states)	Yes	No
Three-toed woodpecker	No	No	No	Yes	No
Black-backed woodpecker	Yes	No	No	Yes	No
Olive-sided flycatcher	No	No	No	No	No
Western wood-pewee	No	No	No	No	No
Peregrine falcon	Yes	No	Yes (both states)	No	No
Gray wolf	No	Yes (endangered)	Yes (both states)	No	No
Wolverine	Yes	Yes (proposed)	Yes (both states)	No	No
Pygmy horned lizard	No	No	No	No	No
Side-blotched lizard	No	No	No	No	No
Striped whipsnake	No	No	Yes (Washington)	No	No
Ferruginous hawk	No	No	No	No	No
Golden eagle	Yes	No	No	No	No
Prairie falcon	No	No	No	No	No
Mourning dove	No	No	No	No	No
Common nighthawk	No	No	No	No	No
Common poorwill	No	No	No	No	No

Common Name	Surrogate Species	Federally Listed	Sensitive	Management Indicator Species	Focal
White-throated swift	No	No	No	No	No
Black-billed magpie	No	No	No	No	No
Rock wren	No	No	No	No	No
Lark sparrow	Yes	No	No	No	No
Brewer's blackbird	No	No	No	No	No
Western small-footed myotis	No	No	No	No	No
Yuma myotis	No	No	No	No	No
Spotted bat	No	No	Yes (Oregon)	No	No
Pallid bat	Yes	No	Yes (both states)	No	No
Ash-throated flycatcher	Yes	No	Yes (Washington)	No	No
Pinyon jay	No	No	No	No	No
Sagebrush lizard	No	No	No	No	No
Night snake	No	No	No	No	No
Gray flycatcher	No	No	Yes (Washington)	No	No
Loggerhead shrike	Yes	No	No	No	No
Green-tailed towhee	No	No	Yes (Washington)	No	No
Merriam's shrew	No	No	No	No	No
Desert horned lizard	No	No	No	No	No
Greater sage-grouse	No	No	Yes (Oregon)	No	No
Sage thrasher	Yes	No	No	No	No
Brewer's sparrow	No	No	No	No	No
Black-throated sparrow	No	No	No	No	No
Sage sparrow	No	No	No	No	No
Pygmy rabbit	No	No	Yes (Oregon)	No	No
Black-tailed jackrabbit	No	No	No	No	No
Sharp-tailed grouse	No	No	Yes (Oregon)	No	No
Long-billed curlew	No	No	No	No	No
Burrowing owl	No	No	No	No	No
Horned lark	No	No	No	No	No
Oregon vesper sparrow	No	No	No	No	No
Western meadowlark	No	No	No	No	No
Preble's shrew	No	No	Yes (Washington)	No	No
White-tailed jackrabbit	No	No	No	No	No
Sagebrush vole	No	No	No	No	No
American badger	No	No	No	No	No
Pronghorn	No	No	No	No	No
Mountain goat	No	No	Yes (Washington)	No	No
Rocky Mountain bighorn sheep	Yes	No	No	No	No
California bighorn sheep	Yes	No	No	No	No
Northern harrier	Yes	No	No	No	No
Swainson's hawk	No	No	No	No	No
Short-eared owl	No	No	No	No	No

Common Name	Surrogate Species	Federally Listed	Sensitive	Management Indicator Species	Focal
Grasshopper sparrow	No	No	Yes (Oregon)	No	No
Townsend's big-eared bat	Yes	No	Yes (both states)	No	No
Mountain quail	No	No	Yes (Washington)	No	No
Yellow-billed cuckoo	No	No	No	No	No
Western screech-owl	No	No	No	No	No
Black-chinned hummingbird	No	No	No	No	No
Broad-tailed hummingbird	No	No	No	No	No
Red-naped sapsucker	Yes	No	No	No	No
Willow flycatcher	No	No	No	No	No
Red-eyed vireo	No	No	No	No	No
Barn swallow	No	No	No	No	No
Black-capped chickadee	No	No	No	No	No
Veery	No	No	No	No	No
Orange-crowned warbler	No	No	No	No	No
Yellow warbler	No	No	No	No	No
American redstart	No	No	No	No	No
MacGillivray's warbler	Yes	No	No	No	No
Wilson's warbler	No	No	No	No	No
Yellow-breasted chat	No	No	No	No	No
White-crowned sparrow	No	No	No	No	No
American goldfinch	No	No	No	No	No
Water shrew	No	No	No	No	No
Inland tailed frog	Yes	No	Yes (both states)	No	No
Black swift	Yes	No	Yes (Oregon)	No	No
Great blue heron	No	No	No	No	No
Black-crowned night-heron	No	No	No	No	No
Wood duck	Yes	No	No	No	No
Harlequin Duck	Yes	No	Yes (both states)	No	No
Bufflehead	No	No	Yes (Oregon)	No	No
Common goldeneye	No	No	No	No	No
Barrow's goldeneye	No	No	No	No	No
Hooded merganser	No	No	No	No	No
Common merganser	No	No	No	No	No
Bald eagle	Yes	No	Yes (both states)	No	No
Western toad	No	No	No	No	No
Columbia spotted frog	Yes	No	Yes (Oregon)	No	No
Northern leopard frog	No	No	No	No	No
Painted turtle	Yes	No	Yes (Oregon)	No	No
Spotted sandpiper	No	No	No	No	No
American bittern	No	No	No	No	No
Virginia rail	No	No	No	No	No
Marsh wren	Yes	No	No	No	No
Tricolored blackbird	No	No	Yes (Oregon)	No	No

Common Name	Surrogate Species	Federally Listed	Sensitive	Management Indicator Species	Focal
Yellow-headed blackbird	No	No	No	No	No
Sandhill crane	No	No	No	No	No
Black-necked stilt	No	No	No	No	No
American avocet	No	No	No	No	No
Greater yellowlegs	No	No	No	No	No
Willet	No	No	No	No	No
Wilson's snipe	Yes	No	No	No	No
Wilson's phalarope	No	No	No	No	No
Bobolink	No	No	Yes	No	No
Eared grebe	Yes	No	No	No	No
Blue-winged teal	No	No	No	No	No
Northern shoveler	No	No	No	No	No
Northern pintail	No	No	No	No	No
Green-winged teal	No	No	No	No	No
Canvasback	No	No	No	No	No
Redhead	No	No	No	No	No
Ring-necked duck	No	No	No	No	No
Lesser scaup	No	No	No	No	No
Ruddy duck	No	No	No	No	No

Terrestrial Species Viability

The National Forest Management Act requires the Forest Service to manage fish and wildlife habitat to maintain viable populations of native and desirable nonnative vertebrate species and conserve all listed threatened or endangered species populations (36 CFR 219.19). The 1982 regulations define a viable population as one for which the number and distribution of reproductive individuals would “insure its continued existence.” Considerable new science has developed since the original Forest Plans were completed concerning the viability of a wide array of wildlife species that are present within the Blue Mountains forest plan revision Plan Area (Lehmkuhl et al. 1997, Wisdom et al. 2000, Raphael et al. 2001). In addition, methods for assessing species viability have evolved (Soule 1987, Marcot et al. 2001, Beissinger and McCullough 2002, Suring et al. 2011), and choosing which species to assess that best represent other species has changed considerably. Andelman et al. (2001) conducted a review of viability assessments conducted under the National Forest Management Act and concluded that there was no single accepted or standardized approach for viability analysis, and the debate continues at the national level. Comprehensive viability analysis requires significant data inputs on species demography and life history that are, to this day, unavailable for most species (Ruggiero et al. 1994). The fact that a species occurs in an area is indicative of its persistence, but species generally are tolerant of a range of environmental conditions, resulting in increasingly complicated predictions when using models (Haufler et al. 1996).

We used the surrogate species approach to evaluate species and ecosystem viability following direction and guidance provided by Pacific Northwest Region Planning (USDA Forest Service 2010).

The surrogate species approach is intended to inform the management of sustainable ecosystems, and it is not expected that the population dynamics of a surrogate species would necessarily represent the population dynamics of another species (Lambeck 1997). The concept of surrogate species differs from management indicator species described in the 1982 planning regulations written to implement the National Forest Management Act (36 CFR 219.19). The use of management indicator species was considered a means of evaluating the effects of management actions on a suite of species whose population trends were assumed to reflect changes in habitat amount and quality that result from management actions (Suring et al. 2011). This assumption and the management indicator species concept have been called into question in the past two decades (Landres et al. 1988, Andelman et al. 2001). As a result, the management indicator species concept evolved to the more robust concept of surrogate species in the late 1990s (Lambeck 1997). Surrogate species are now considered a more appropriate approach in addressing species and ecosystem viability (Wiens et al. 2008, Suring et al. 2011).

The approach used to evaluate the ecological conditions capable of sustaining viable populations of wildlife species is described in detail in Suring et al. (2011) and Gaines et al. (2017). In summary, an eight-step process was used to assess the ecological conditions capable of sustaining viable populations of terrestrial wildlife species. The process included:

1. identification of species with potential viability concerns,
2. description of source habitats, and other important ecological factors,
3. organizing species into groups,
4. selection of surrogate species for each group,
5. development of surrogate species assessment models,
6. application of the surrogate species assessment models to evaluate current and historical conditions,
7. development of conservation strategies, and
8. designing monitoring and adaptive management.

Following the application of species screening criteria, 175 species were identified as species with potential viability concerns within the Plan Area. Those 175 species were then aggregated into 10 families (these are not phylogenetic families) and 23 groups based primarily on their habitat associations. Next, 23 surrogate species (78 percent birds, 13 percent mammals, 9 percent amphibians) were selected for use in the Blue Mountains Forest Plan revision viability assessments, based on risk factors and ecological characteristics (Wales et al. 2011).

Surrogate species are grouped according to habitat associations (Table 328). Additionally, the table associates all of the sensitive, federally listed, and MIS/Focal species for the Blue Mountains to groups and families. Based upon knowledge of ecological relationships of the species evaluated, the smallest number of groups possible was chosen that still allow a meaningful aggregation of species and habitats reflecting important patterns in source habitats. Groups were then aggregated into families to help describe how similar groups of species are related to each other. Families include one or more groups that are associated with similar broad scale vegetative conditions. These generalized vegetative conditions are often used by managers to interpret broad scale patterns and trends. By using a hierarchical evaluation of species, groups, and families, the analysis process addresses single- and multi-species needs as well as identifying broad-scale patterns of habitat change, as did Wisdom et al. (2000).

Analysis Assumptions

Several overriding assumptions are used throughout this assessment. **A key assumption is that managing for the historical range of variability across ecosystems will result in maintaining viability for most species.** Therefore, if management activities can produce conditions close to or within historical range of variability, species that are adapted to these conditions will have a stronger likelihood of persistence (Aplet and Keeton 1999, Landres et al. 1999, Swanson et al. 1994). Use of historical range of variability relies on two concepts: that past conditions and processes provide context and guidance for managing ecological systems today, and that disturbance-driven spatial and temporal variability is a vital attribute of nearly all ecological systems. Approximating historical conditions for source habitats provides a management strategy likely to sustain diverse surrogate species, even for those species where little information is available (Hunter et al. 1988, Landres et al. 1999, Swanson et al. 1994). Similarly, because of limited understanding about ecosystems, approximating past conditions offers one of the best means for predicting and reducing impacts to current ecosystems (Kaufmann et al. 1994). Therefore, if the amount and structure of source habitats are within historical range of variability, associated wildlife species will have a greater likelihood of sustainability than if the amount and structure of source habitats are outside historical range of variability (Raphael et al. 2001, Spies et al. 2006).

Throughout this analysis, acres of potential vegetation groups, road miles, acres of treatments, etc., are all best estimates based on the information available at the time. Change in forested vegetation was simulated using the vegetation dynamics development tool (VDDT) model (see the Forest Vegetation, Timber Resources, and Wildland Fire sections for detailed discussion of VDDT). The analysis using these estimates is intended to indicate the relative differences between alternatives and is not intended to predict absolute amounts of activities, outputs, or effects.

The use of the surrogate species approach is a credible and scientifically rigorous method to assess ecosystem conditions that contribute to the viability of wildlife species (Gaines et al. 2017). The baseline conditions for Surrogate Wildlife Species in the Blue Mountains Plan Revisions Plan Area are presented in Wales et al. (2011) and give reasonable approximations of conditions at the scale of a watershed (10th Code HUC) that are influencing surrogate species habitats and populations. Trends in population viability were determined at the national forest scale.

Modeling future habitat trends for a select group of surrogate wildlife species required several assumptions, most importantly, that habitat associations for each species were adequately represented by the identified model states, and that the effects of forest management treatments were adequately reflected in effects on habitat conditions (Lambeck 1997, Wiens et al. 2008).

The long-term sustainability of a surrogate species is assumed to be representative of a group of species with similar ecological requirements, and this group is assumed to respond in a similar manner to environmental change (Suring et al. 2011). By providing for adequate amounts and distribution of habitat and managing risks for surrogate species, it is assumed that the ecological conditions needed to maintain viability of other associated species will also be provided (USDA Forest Service 2010).

It is also assumed that implementing projects following the guidance of the Forest Plan would impact at least one individual of each species during the plan period. Disruptions to an individual’s normal behavior patterns, such as breeding, foraging, and sheltering, are considered

impacts to that individual. For example, it is assumed that wildland fire would be used as a management tool to help achieve desired conditions outlined in the Forest Plan. Inherently the use of fire will disrupt the normal behavior of species due to smoke and could actually cause mortality in less mobile species, such as land snails. Snags and down logs are also vulnerable to loss from fire (Bagne et al. 2008, Randall-Parker and Miller 2002). It is reasonable to assume that during the plan period at least some snags/down logs that provide shelter, nest sites, plucking posts, or foraging structure for various species would be lost, therefore disrupting an individual's behavior.

Another example would be ground nests. Although considered a random event (Jensen et al. 1990) with a low probability of occurrence (Beck and Mitchell 2000), Fondell and Ball (2004) documented that the nests of grassland species in Montana were destroyed by livestock trampling. Since domestic livestock would graze within the national forests, it is likely that at least some individuals would be disturbed. Likewise, prescribed burning in the spring season would be expected to consume nests and kill young or eggs of some ground nesting birds.

Although Hamann et al. (1999) focused on birds, other authors (Boyle and Samson 1985, Gaines et al. 2003, Taylor and Knight 2003) have documented the impacts of recreation on wildlife, which include the continuum of responses from habituation at one extreme to habitat abandonment at the other. Whether it is a snowmobile that disturbs a wolverine's foraging behavior or a hiker scrambling up a talus slope crushing a snail, individual animals will most likely be impacted by recreational activity during the life of the plan.

Forest plans do not actually authorize site-specific activity but provide the umbrella under which projects would be designed and implemented. Project level analysis would be based on current and more site-specific information about existing conditions where the actions would be proposed. Historical conditions, current conditions, and desired conditions would be analyzed at a finer scale of resolution to better predict project outcomes. As such, it is assumed that the conditions presented in this analysis are representative of conditions as a whole across the national forest; however, there are sites within the national forest that, when analyzed at the project scale, would not be representative of the bigger picture (for example, grazing intensity on an individual allotment that may exceed what would be presented for the national forest as a whole).

The Forest Service developed alternatives that have desired conditions for vegetation that strive to be within the bounds of the historical range of variability. The potential to diminish biological diversity is greater if current and anticipated conditions are outside and remain outside the historical range of variability. As stated previously, the effects described in this Environmental Impact Statement are designed to show the relative differences between alternatives but not precisely predict the amount or location of management activities that would occur during the plan period should an alternative be selected for implementation.

Terrestrial Species Viability – Environmental Consequences

This analysis describes how alternatives contribute to, address, or mitigate patterns of habitat alteration and fragmentation and wildlife disturbance, and identifies terrestrial source habitat that occur at levels less than estimates for the historical, forest-wide scale. The discussion includes how alternatives address:

- progress towards achieving habitat desired conditions
- species that have a viability concern
- species affected by human influences

In particular, the analysis focuses on species and their habitats where sustainability may be affected and/or where the species has status as a Federal threatened, endangered, proposed, or candidate species or as a Regional Forester's Sensitive Species.

Changes in wildlife habitat occur at several scales and at differing intensities depending on the home range size and habitat requirements of individual species. The desired conditions are the same for the plan revision alternatives, while management area designations, standard and guidelines, and the anticipated amount and rate of progress towards achieving desired conditions vary. Therefore, effects analyses for wildlife are broad, forest-wide, and programmatic by design. The effects from probable management activities that could potentially affect wildlife communities can be grouped into three broad categories:

1. **Source habitat abundance:** Source habitats were defined as those providing characteristics of macro-vegetation that contribute to stationary or positive population growth (Wisdom et al. 2000). Source habitats are distinguished from habitats simply associated with species occurrence and may or may not contribute to long-term population persistence (Wisdom et al. 2000). The macro-habitats used by each of the species considered in our assessment were described using cover type and structural stage (Wales et al. 2011). Source habitats included in the habitats used for reproduction, movement, and cover (e.g., protection, thermoregulation) are described by Johnson and O'Neil (2001), other primary literature, and professional judgment.

   Habitat changes from management activities would affect wildlife. Restoration, regeneration, and forest health goals exist for each alternative. The management activities needed to achieve those goals could include timber harvest; fuel treatments; livestock grazing; road reconstruction, maintenance, and decommissioning; prescribed fire; managed wildland fire; planting; and other similar activities. The Vegetation Dynamics Development Tool, a modeling program, was used to project changes in vegetation from management actions as well as natural disturbances (wildfire, insects and diseases).

2. **Habitat quality factors:** For many surrogate species, the quality of source habitat was assessed based on information such as the density of snags and logs, patch size of source habitat, or amount of shrubs. Based on plan components of each alternative the potential effects of these habitat quality factors for each surrogate species was evaluated.

3. **Other risk factors:** Risk factors attributed to human activities were identified from literature review and/or species experts (Wales et al. 2011). Based on the plan components for each alternative, the influence of these factors was evaluated for each surrogate species.

General Effects of National Forest Management

What follows is a description of general effects to wildlife habitat from other resource management activities. Although the amount or distribution of these activities differs by alternative, the general types of effects from the activities would be the same for all alternatives.

Timber Harvest

Timber harvest activities would alter vegetation components that comprise habitat for almost all terrestrial species. Harvesting can change vegetation composition, density, size, amounts, and distribution, and move successional trend toward or away from historical range of variability. These changes in vegetation can have positive or negative effects on different species (Bunnell et al. 1997, Zwolak 2009). For example, past harvest of late old structure pine was detrimental to the white-headed woodpecker, a species that depends on large trees and snags, but may have been beneficial for other species, such as the fox sparrow, that prefer open, brushy habitats (Finch et al. 1997). Post-fire salvage logging can reduce the use of an area by cavity-nesting species, such as the black backed woodpecker, that evolved with fires where trees were not removed (Cahall and Hayes 2009) but may result in more favorable conditions for Lewis's woodpecker (Saab et al. 2007).

The mechanical processes involved in timber harvest often cause disturbance to wildlife because of equipment use or human presence. In areas where roads are built and maintained for long-term use, vehicle access can increase threats to some wildlife species (Forman 2000, Frair et al. 2008, Trombulak and Frissell 2000). Snags are usually removed adjacent to roads for safety reasons, and roads provide ready access to people wanting firewood (Bate et al. 2007). This reduces the habitat for species that require snags/logs. The timing of activities can also have different effects. For instance, localized harvest activities may disturb elk calving during a relatively short period in the spring, but not at other times of the year.

Fire Management

Fire management activities change vegetation. Fire use or its exclusion can change vegetation composition, density, size, and amount and distribution of both live and dead material, as well as successional trends (Kennedy and Fontaine 2009).

Long-term fire exclusion causes an increase in vegetation quantity above levels that were historically present. In white-headed woodpecker habitat, this has caused a reduction in habitat quality because of increasing tree density and higher composition of shade-tolerant tree species (Altman 2000). Long-term fire exclusion in the same type of habitat has benefitted other species, such as the pileated woodpecker, that prefer multi-storied tree stands and abundant snags and logs for feeding sites (ibid). The timing of fire can have different effects. Historically, fire created disturbance that altered vegetation at fairly regular intervals and at intensities that varied by potential vegetation group (Saab et al. 2007). Vegetation and animals evolved with fire, which is a common disturbance in many environments. As discussed, the change in vegetation resulting from fire can have positive or negative effects on different species depending on fire intensity, frequency, and timing.

Alternatives vary in the tradeoffs of fire risk to vegetation change. Potential effects to wildlife habitat and species from fire management will vary by alternative theme and management area assignments.

Livestock Grazing

Domestic livestock grazing directly competes with wildlife for the use of available forage. Grazing results in plant defoliation, mechanical changes to soil and plant material, and nutrient redistribution (Belsky and Blumenthal 1997). These and other factors also influence successional trends. Succession is affected by the grazing frequency (times grazed), intensity (amount of plant removal), and opportunity (time the plant needs to meet its physiological growth needs). Timing

(spring, summer, and/or fall) of grazing can also have different effects on vegetation, such as reduction of flowering parts or physical damage to plants if conditions are too wet in the spring. Grazing can alter the density and composition of herbaceous and shrub vegetation, which can have either a positive or negative effect on wildlife (Bock et al. 1993, Finch et al. 1997, Short and Knight 2003). Vegetation is sometimes altered to increase forage for livestock, which also increases forage for some wildlife species.

The presence of livestock can affect some wildlife species by attracting cowbirds in open forest settings, which lay eggs in (parasitize) other bird nests (Friedmann 1963). The presence of livestock may be giving cowbirds an ecological advantage over other bird species in the area (Goguen and Mathews 1998). In all cases, it is important to distinguish between historical and current livestock impacts. For example, some species, such as mule deer (Clements and Young 1997, Mule Deer Working Group 2003), and some bird species that rely on shrubs for nesting may have actually benefitted from the early heavy grazing in the West (Saab et al. 1995).

Grazing by domestic sheep can increase the risk of disease transmission to bighorn sheep. Bighorn sheep are highly susceptible to pneumonia caused by *Mycoplasma ovipneumoniae* carried by domestic sheep (Besser et al. 2012). The disease, which has negligible effects to domestic sheep, is usually fatal to bighorn sheep. Transmission of the disease can occur when bighorn sheep and domestic sheep occupy the same area (Coggins 2002, Clifford et al. 2009).

Road and Trail Construction and Use

The majority of roads constructed on National Forest System lands during the last 50 years have been developed primarily for timber management activities. Historically, trails were developed for livestock management activities, mining, and fire lookout access. More recently, however, trails have been constructed for recreational activities.

Construction and use of roads and trails removes vegetation from the travel surface. This removal directly reduces the amount of vegetation that can be used as habitat and indirectly affects adjacent habitat (Frair et al. 2008). The relative effects of roads on wildlife depend on the interaction of topography, vegetation type and condition, and frequency of human use (Edge and Marcum 1991). One of the primary direct effects is increased human access to areas. Improved access increases mortality risk, fragmentation of habitat, and displacement/avoidance responses (Trombulak and Frissell 2000). Access can increase the risk of nonnative plants becoming established, and many of these plants are not used as habitat or forage by native wildlife. Access on roads and trails can be restricted during certain times of the year to reduce or eliminate these effects; however, the increasing human population trend for Oregon is likely to continue, and growth will likely increase human use of public lands during all seasons of the year.

Minerals Management

Mining exploration and development can influence wildlife in a number of ways, including road construction to mineralized areas, increased human interaction, and loss of vegetation that was used as habitat (Wilcove et al. 1998). Mining at the turn of the twentieth century influenced extensive areas and resulted in considerable changes to the landscapes where it occurred. Dredging of areas like Sumpter Valley left a highly scarred landscape that is just recently beginning to recover. Some of the first roads constructed were to gain access to mineral deposits. Mining operations have different requirements for support facilities and access. In areas where mineral reserves justify the construction of a mill, impacts may include buildings, equipment, utilities, tailings, and human presence. Today most mining is in the form of placer mining. Even

though significant mineral exploration and development operations must be approved by the authorized officer, these activities are still a ground-disturbing activity with a higher level of human activity that is not always compatible with wildlife.

The scale of mineral development has differing effects on habitat and displacement/avoidance associated with the extent, timing, and duration of activities. Exploration activities are usually brief compared to mineral production, which can displace wildlife for many years in some cases. Some mining activities use or produce toxic material. If improperly handled, this material can cause mortality to wildlife.

The ability to access minerals would be the same for each alternative; therefore, effects to habitat and wildlife species would not vary. Mineral development is a function of worldwide market values. Areas with unique characteristics which cannot be protected by existing regulations may be withdrawn from mineral exploration or development by Congress or administratively. No lands have been identified for administrative withdrawal through plan revision, although land allocation decisions could indirectly influence mineral withdrawals in the future, depending on Congressional action.

Recreation

Recreation is a function of social demands related to desired, available, and provided experiences on National Forest System lands. Developed and dispersed camping can decrease the habitat capability for some species (Cole and Landres 1995). Wildlife species that require snags are usually negatively affected by hazard tree removal (for safety reasons) and firewood collection. Long-term use of dispersed sites can modify the vegetation that wildlife species depend on. Wildlife disturbance or disruption from recreation during breeding/nesting periods can also occur (Boyle and Samson 1985, Saab 1998).

Winter recreation, such as cross-country skiing and snowmobiling, can stress wintering animals during deep snow periods (Eckstein et al. 1979, Goldberg 2010, Goodrich and Berger 1994). Over-the-snow trails provide some animals with access to areas they usually cannot use during the winter because of deep snow conditions (Bunnell et al. 1990).

The increasing human population trend for Oregon is likely to continue. Likewise, the public desire for differing recreational activities will continue to increase. This increase in recreation use has resulted in increased conflicts with wintering wildlife, particularly big game. Most big game winter ranges have motorized access restrictions to reduce stress to wildlife during periods of deep snow; additional restrictions for big game winter ranges are not anticipated.

Though none of the alternatives would actively promote an increase in recreational use of National Forest System lands, in all likelihood, recreation demand within the National Forests will increase during the plan period as the human population increases.

General Effects of Nonnative Plants

Over time, many nonnative plants have been introduced into the Plan Area. Some plants were intentionally introduced while others were not. Nonnative plants change the value of wildlife habitat by displacing native plant species. Some nonnative species are not usable by native wildlife species as habitat or forage, and their presence decreases the habitat carrying capacity. Some nonnative plants influence fire regime and create conditions that may cause areas to burn more frequently. An increasing fire frequency can cause a reduction in woody species that are

valuable as habitat. Additionally, nonnative plants compete with native vegetation for moisture, nutrients, and space, all of which can reduce habitat quality and quantity.

Surrogate Species

It is important to note that surrogate species were referred to as focal species in the Draft Environmental Impact Statement but the name was changed to avoid confusion with focal species as defined in the monitoring requirements of the 2012 Planning Rule.

The surrogate species assessment is intended to assist in the development of forest plans by helping frame the goals and desired conditions for ecosystems within the landscape, the management focus for implementing the plan, the anticipated accomplishments during the life of the plan, and the development of standards and guidelines where the risks and/or threats were not sufficiently ameliorated through other plan components. This section examines how the management alternatives for forest plan revision either contribute to or mitigate the changing patterns of habitat alteration and fragmentation and disturbance to wildlife.

A detailed analysis for these species (Wales et al. 2011) is in the project record but, in general, existing source habitats were more than 40 percent of the historical median at the watershed scale (Denoël and Ficetola 2007, Olson et al. 2004, Radford et al. 2005, Svancara et al. 2005, Tear et al. 2005, With and Crist 1995), were adequately distributed across the landscape, and threats/risks had been reduced to an acceptable level. Because the threats and risks are similar for several surrogate species, they are grouped by risk factor (Table 329).

Existing Condition – Surrogate Species Viability

Evaluation of the current conditions within the assessment area documented reductions in the viability outcomes (Table 330) for nearly all surrogate species compared to historical conditions (Wales et al. 2011). The species for which current viability outcomes are most similar to historical viability outcomes on the Umatilla National Forest include the northern goshawk, American marten, peregrine falcon, and lark sparrow. Species for which current viability outcomes have departed the most from historical viability outcomes on the Umatilla National Forest include the Cassin’s finch, western bluebird, white-headed woodpecker, and ash-throated flycatcher. The species with the least departure between current and historical viability outcomes on the Malheur National Forest include the northern goshawk, pileated woodpecker, and lark sparrow. The species with the greatest degree of departure between current and historical viability outcomes on the Malheur National Forest include the boreal owl, Cassin’s finch, white-headed woodpecker, Western bluebird, fox sparrow, Lewis’s woodpecker, wolverine, and ash-throated flycatcher. On the Wallowa-Whitman National Forest the species whose current viability outcomes are most similar to the historical viability outcomes include the northern goshawk, peregrine falcon, lark sparrow, and water vole. Species whose current viability outcomes departed the most from the historical outcomes on the Wallowa-Whitman National Forest include the Cassin’s finch, white-headed woodpecker, western bluebird, and wolverine.

Table 329. A list of wildlife surrogate species addressed in the viability assessment for the Blues Forest Plan revision and their habitat associations and risk factors

Surrogate Species	Habitat Associations	Risk Factors
American Marten	Cool/Moist Forest with medium-large trees	Road density, Timber harvest, created openings, habitat loss
Ash-throated Flycatcher	Juniper Woodland	Grazing, habitat loss
Bald Eagle	Riparian	Human Disturbance, habitat loss
Black-backed Woodpecker	Post-fire	Road Density, Post-fire Harvest, habitat loss
Boreal Owl	Alpine/Boreal Forest - Snags	Road Density, habitat loss
Cassin Finch	Forested habitats with medium-large trees	Grazing, habitat loss
Columbia Spotted Frog	Riparian	Invasive species, grazing, road density, habitat loss
Fox Sparrow	Open-forest/Early successional	Grazing, habitat loss
Lark Sparrow	Woodland/Grass/Shrub-Grassland	Invasive species, Grazing, habitat loss
Lewis's Woodpecker	Post-fire	Road Density, habitat loss
MacGillivray's Warbler	Riparian	Grazing, invasive species, habitat loss
Marsh Wren	Wetland	Invasive Species, Habitat loss
Northern Goshawk	Forested habitats with large trees	Human disturbance, loss of old forest habitat
Northern Harrier	Woodland/Grass/Shrub-Grassland	Grazing, human disturbance, habitat loss
Peregrine Falcon	Habitat generalist/Cliff	Human disturbance, habitat loss
Pileated Woodpecker	Cool/Moist Forest with medium-large trees and snags	Road density, habitat loss
Rocky Mountain Tailed Frog	Riparian	Grazing, road density, invasive species, habitat loss
Sage Thrasher	Woodland/Grass/Shrub-Shrub-steppe	Invasive species, Road density, habitat loss
Water Vole	Riparian	Grazing, habitat loss
Western Bluebird	Open-forest/All forest with snags	Road Density, Grazing, habitat loss
White-headed Woodpecker	Dry Forest with medium-large trees and snags	Road Density, habitat loss
Wilson's Snipe	Wetland	Habitat loss
Wolverine	Habitat generalist	Winter recreation, Road density, habitat loss

Table 330. Current and historical viability outcomes for surrogate wildlife species assessed on the Malheur, Umatilla and Wallowa-Whitman National Forests

Surrogate Wildlife Species	Malheur Historic	Malheur Current	Umatilla Historic	Umatilla Current	Wallowa-Whitman Historic	Wallowa-Whitman Current
American Marten	B/C	D/E	A	A	A	B
Ash-throated Flycatcher	A	D	A	D	*	*
Bald Eagle	A	B	B	C	B	C
Black-backed Woodpecker	A	C	A	C	A	B
Boreal Owl	B	E	A	C	A	C
Cassin's Finch	A	D	A	C/D	A	D
Columbia Spotted Frog	A	C	A	C	A	B
Fox Sparrow	A	D	A	C	A	C
Lark Sparrow	B	B	B	B	A	A
Lewis's Woodpecker	A	C/D	A	C	A	C
MacGillivray's Warbler	A	C	A	C	A	C
Marsh Wren	A	B	A	B	A	B
Northern Goshawk	A	A	A	A	A	A
Northern Harrier	A	B	A	B	A	B
Peregrine Falcon	*	*	B	B/C	B	B/C
Pileated Woodpecker	A	A	A	B	A	C
Rocky Mountain Tailed-frog	*	*	A	B	A	C
Sage Thrasher	B	C	B	C	B	C
Water Vole	A	B	A	B	A	A
Western Bluebird	A	D	A	D	A	D
White-headed Woodpecker	A	E	A	E	A	E
Wilson's Snipe	A	B	A	B	A	B
Wolverine	A	E	B	C/D	A	D

* Did not assess due to very limited habitat or species is not present on the National Forest

Environmental outcomes defined in Raphael et al. (2001) were used as a basis to describe five viability outcomes. These outcomes were calculated for current and historical conditions for each surrogate species to assess changes in habitat conditions. The term "suitable environment" refers to a combination of source habitat and risk factors that influence the probability of occupancy and demographic performance of a surrogate species. The viability outcomes are based on departure from historical conditions. The five viability outcomes we used were:

1. **Outcome A**—Suitable environments are broadly distributed across the historical range of the species throughout the assessment area. Habitat abundance is high relative to historical conditions. The combination of distribution and abundance of environmental conditions provides opportunity for continuous or nearly continuous intraspecific interactions for the surrogate species.

2. **Outcome B**—Suitable environments are broadly distributed across the historical range of the species. Suitable environments are of moderate to high abundance relative to historical conditions, but there may be gaps where suitable environments are absent or present in low abundance. However, any disjunctive areas of suitable environments are typically large enough and close enough to permit dispersal among subpopulations and to allow the species to potentially interact as a metapopulation. Species with this outcome are likely well distributed throughout most of the assessment area.
3. **Outcome C**—Suitable environments moderately distributed across the historical range of the species. Suitable environments exist at moderate abundance relative to historical conditions. Gaps where suitable environments are either absent or present in low abundance are large enough such that some subpopulations may be isolated, limiting opportunity for intraspecific interactions especially for species with limited dispersal ability. For species for which this is not the historical condition, reduction in the species' range in the assessment area may have resulted. Surrogate species with this outcome are likely well distributed in only a portion of the assessment area.
4. **Outcome D**—Suitable environments are low to moderately distributed across the historical range of the species. Suitable environments exist at low abundance relative to their historical conditions. While some of the subpopulations associated with these environments may be self-sustaining, there is limited opportunity for population interactions among many of the suitable environmental patches for species with limited dispersal ability. For species for which this is not the historical condition, reduction in species' range in the assessment area may have resulted. These species may not be well distributed across the assessment area.
5. **Outcome E**—Suitable environments are highly isolated and exist at very low abundance relative to historical conditions. Suitable environments are not well distributed across the historical range of the species. For species with limited dispersal ability there may be little or no possibility of population interactions among suitable environmental patches, resulting in potential for extirpations within many of the patches, and little likelihood of recolonization of such patches. There has likely been a reduction in the species' range from historical conditions, except for some rare, local endemics that may have persisted in this condition since the historical period. Surrogate species with this outcome are not well distributed throughout much of the assessment area.

There is a need to address the viability concerns for surrogate species identified in the assessment of the current conditions (Wales et al. 2011). By addressing the habitat needs and risk factors identified for surrogate species, ecological conditions capable of supporting viable populations of all native and non-native desirable wildlife species, including Pacific Northwest Region sensitive species, would be enhanced. Some key findings of the assessment include:

- Riparian habitats are important for a wide variety of the surrogate species assessed. A strategy that protects and restores riparian habitat, including addressing the effects of roads and domestic grazing, is needed.
- Late-successional and old forest habitats are generally below their historical range of variability. In some forest types, such as the dry and mesic forests, active restoration of old-forest habitat is needed to restore important habitat structures (like large trees) and to reduce risk of habitat loss due to uncharacteristically severe wildfires.
- One of the primary reasons for species viability outcomes being reduced is the widespread influence of roads. Roads decrease habitat effectiveness by increasing human access,

resulting in displacement/avoidance responses from wildlife. Roads also increase wildlife mortality risk, fragment habitat, increase sediment runoff, facilitate the spread of invasive species, and are associated with reduced snag densities. Restoring habitat effectiveness, by reducing the effects of roads, is important for several surrogate wildlife species.

- Restoring the connectivity of wildlife habitats is an important strategy for addressing the effects of climate change on wildlife populations, especially within riparian habitats. Habitat connectivity is a function of the amount of habitat, the spatial arrangement, and how human activities influence the effectiveness of the habitat. Roads are known to influence the connectivity and effectiveness of habitat for surrogate wildlife species.
- The availability of large and old trees and large snag habitat is generally lacking in many forest types because of past management practices and altered disturbance regimes. Restoration of these key habitat components is important for several surrogate wildlife species.

The Region 6 terrestrial species viability assessment process (USFS 2010) was used to model and evaluate alternatives C, E-Modified, and E-Departure. This approach is described in detail in Suring et al. (2011), Wales et al. (2011), and Gaines et al. (2017). The terrestrial species viability assessment process was completed for the Plan Area in order to determine the baseline conditions for each of the surrogate species (Wales et al. 2011) and to identify risk factors that influence the viability of surrogate wildlife species (Table 330). These habitat and risk factors were addressed in each of the alternatives and used to evaluate how each alternative contributes to or detracts from the viability of surrogate wildlife species. Alternatives A, B, D, E, and F were qualitatively analyzed using information from modeled habitat trends and plan components.

Spatial and Temporal Context for Effects Analysis

Surrogate wildlife species were assessed at two spatial scales. Direct, indirect and cumulative effects were assessed for each species using the watershed (10th Code HUC) as an evaluation unit, considering all land ownerships within the watershed (Suring et al. 2011, Wales et al. 2011). Individual watershed results were then used to determine a most-likely viability outcome for each alternative and for each national forest (Umatilla, Wallowa-Whitman, and Malheur National Forests). The current and estimated historic viability outcomes were quantitatively and qualitatively assessed for each surrogate species (see Wales et al. 2011, Appendix B) in order to establish baseline conditions upon which changes to habitat and risk factors could be compared and evaluated.

Future habitat trends were modeled for the following surrogate species: American marten, black-backed woodpecker, boreal owl, Cassin’s finch, fox sparrow, Lewis’s woodpecker, northern goshawk, pileated woodpecker, western bluebird, and white-headed woodpecker (Appendix C). These trends were modeled to assess habitat conditions at 20 and 50 years in order to qualitatively estimate how different management alternatives would contribute to or detract from the viability of surrogate species. Other risk factors that influence the viability of surrogate species were assessed in the short term (no more than 20 years) and the long term (no more than 50 years) using the management direction for each alternative to develop a set of assumptions (Appendix D) about how each of the alternatives would influence habitat, risk factors, and the viability outcomes for each of the focal species.

Key Indicators

Key indicators were used to evaluate the effect of each alternative on the viability of surrogate wildlife species (Table 331). Species were grouped according to the primary risk factor (key indicator) influencing viability (grazing, motorized access, old forest, riparian, snags). Effects are discussed in terms of how each alternative influences the key indicators for each group. While there may be effects outside of these key indicators, this approach provides a way to focus the analysis and display the relative differences between alternatives in light of the predominant risk factors that influence viability and can also be influenced by our management actions.

Table 331. Key indicators used to assess the viability of surrogate wildlife species

Viability Group/Issue	Surrogate Wildlife Species	Key Indicators
The viability of wildlife species associated with old forest structures	**Wildlife species associated with old forest structures** • Cold and Moist Forests (northern goshawk, pileated woodpecker, American marten, Boreal owl, Cassin's finch) • Dry and Mesic Forests (pileated woodpecker, northern goshawk, white-headed woodpecker, Cassin's finch)	• The amount and patch-size of old-forest habitats. • The effect of roads on old-forest habitat effectiveness. • Management direction that addresses habitat and risk factors.
The influence of motorized access on the viability of wildlife species sensitive to human disturbances	**Wildlife species that are sensitive to human disturbances that result from motorized access** • Nonwinter (wolverine, northern goshawk, American marten, bald eagle, peregrine falcon) • Winter (wolverine, bald eagle)	• Measurements of road density and the zone of influence. • Management direction that addresses habitat and risk factors.
The influence of livestock grazing on the viability of wildlife species	**Surrogate wildlife species influenced by grazing** (ash-throated flycatcher, MacGillivray's warbler, Western bluebird, Cassin's finch, fox sparrow, lark sparrow, northern harrier)	• Effects of grazing on the viability and habitat of surrogate species. • Management direction that addresses habitat and risk factors.
The influence of forest management on the viability of surrogate wildlife species associated with riparian habitats	Surrogate wildlife species associated with riparian habitats (water vole, bald eagle, MacGillivray's warbler, Columbia spotted frog, Rocky Mountain tailed frog, marsh wren, Wilson's snipe)	• Vegetation management within riparian management areas. • Grazing effects to riparian habitat conditions. • Road density and Zone of Influence on riparian habitat effectiveness.
The influence of forest management activities on the viability of surrogate wildlife species dependent on snag habitat	Surrogate wildlife species dependent on snag habitats (pileated woodpecker, white-headed woodpecker, black-backed woodpecker, Lewis's woodpecker, western bluebird, boreal owl)	• Availability of snag habitat. • Roads densities. • Management direction that addresses habitat and risk factors.

Direct and Indirect Effects – Old Forest Associated Surrogate Wildlife Species

Forest activities that directly influence the viability of old forest dependent surrogate species include: the loss of old forest habitat from fire (Healy et al. 2008), vegetation treatments (e.g. timber harvest, thinning, prescribed fire) that affect forest structure (e.g., canopy closure, snags,

downed wood)(Healy et al. 2008, Wisdom and Bate 2008), management of roads that influences habitat effectiveness (Gaines et al. 2003), and protection of riparian areas which are an important element of old forest habitats for some species (e.g., bald eagles). Species in this group include the northern goshawk, pileated woodpecker, American marten, boreal owl, white-headed woodpecker, and Cassin's Finch.

Alternative A – No Action

Overall, this alternative limits active management in existing old forest areas, emphasizing short-term habitat protection for old forest closed-canopy species instead of active forest restoration and hazard fuels reduction.

This alternative provides for the viability of old forest species through a system of Old Forest Management Areas (MA-4C Old Forest). MA-4C in this alternative is comprised of generally smaller patches on fewer acres as compared to alternative C, the only other alternative with MA-4C designated. These small patches of old forest habitat function similarly to habitat islands, and are highly susceptible to disturbances such as fire, insects, and tree diseases, with no redundancy or replacement habitat in the event they are lost. This system was based on minimizing the effects of protection of old forest habitat on timber harvest levels. This system was deemed inadequate to provide for the viability of old forest species and thus Forest Plans were amended with the east-side screens (USDA Forest Service 1995). The intent was for the east-side screens to provide interim direction until Forest Plans were revised.

The matrix or area in-between the small islands of old forest habitat is managed primarily through even-aged timber production, with some protections for elements of old forest habitat, such as snags and downed wood. However, the combination of roads and timber harvest generally results in these areas having snag habitat below levels that would maintain viable populations of snag dependent wildlife species. Again, the management direction in the original Forest Plan was deemed inadequate, thus additional direction was adopted through the east-side screens (USDA Forest Service 1995). The east-side screens restrict the cutting of live trees larger than 21 inches in diameter.

With the continuation of the east-side screens, the implementation of this alternative includes a standard to protect active goshawk nests and post-fledgling areas. Additionally, connectivity corridors are to be identified and managed for at the project level. The plan components designed for goshawk and connectivity would all likely be beneficial to other species associated with large tree closed canopied forests.

The implementation of this alternative would likely not reduce the negative effects of roads on old forest and snag habitat more so than the other alternatives. Alternative A includes a road density standard on the Malheur National Forest and Wallowa-Whitman National Forest per management area, while, the Umatilla National Forest describes road densities as a desired condition. Additionally, cross-country motor vehicle use is currently only restricted on the Umatilla National Forest.

This alternative would maintain favorable viability outcomes on all three National Forests for northern goshawk and pileated woodpecker as it limits the use of mechanical treatments and active forest restoration. Although habitats for these species decline through year 50, habitats remain with the historical range of variability. Viability outcomes for boreal owl and Cassin's finch would improve across all three forests under this alternative, although not as much as under some of the other alternatives.

This alternative, similar to Alternative B, would result in no improvement in the viability outcome for surrogate species associated with more open-canopied old forest habitats within dry forests (e.g., white-headed woodpecker) because forest restoration treatments would only occur at a limited spatial scale. The percent of single story dry upland old forest at year 50 on all three forests would range from 9-15 percent, compared to 16-20 percent for Alternative E-Modified Departure. The desired condition for that potential vegetation group is 40-65 percent. Under this alternative, white-headed woodpeckers on all three forests would have a viability outcome of E, meaning that suitable habitat is highly isolated and there is little or no possibility of population interactions among suitable patches of habitat, resulting in potential for extirpations within many of the patches and little likelihood of recolonization of such patches.

Summary: The implementation of this alternative would maintain or increase the viability outcomes of most old forest surrogate wildlife species with the exception of the pileated woodpecker on the Malheur and the American marten on the Wallowa-Whitman. However, the old forest habitat provided by this alternative may not maintain viable populations of old forest surrogate wildlife species associated with large tree open-canopied forests. This alternative does not emphasize restoration of landscape resiliency to reduce the loss of old forest habitats to uncharacteristically severe wildfires. This alternative would not result in the restoration of habitat effectiveness by reducing the negative effects of roads on old forest habitats.

Alternative B

As with all the plan revision alternatives, the desired conditions describe the abundance of different structural stages including older and larger tree forests to be within the range of variation, though the rate and amount of vegetation treatments is less than the other plan revision alternatives except Alternative C.

In Alternative B there are no Old Forest Management Areas (MA 4C) though there are guidelines to provide larger patches of old structure stands to prevent fragmentation of these habitats. Similar to Alternatives C, D, E, and F, there is a guideline to prohibit the construction of new motor vehicle routes in old forest stands.

Similar to Alternatives A and C, the plan components designed for goshawk would all likely be beneficial to other species associated with large tree closed canopied forests. Protection measures for large trees (21 inches diameter and larger) are less than Alternatives A and C because the guideline allows exceptions for trees that compete with hardwoods, early seral species, and in cases of hazard trees or fuel reductions. Snag habitat along roads would continue to be depleted through fuel wood gathering and danger tree management in all alternatives.

Similar to Alternative A, habitat abundance for surrogate species associated with large tree closed canopied forests (boreal owl, goshawk, pileated woodpecker) generally remains about the same through year 50 and remains within the range of variability. Habitats for surrogate species associated with large tree open-canopied forest increase, but because forest restoration treatments would occur at a limited spatial scale, viability outcomes would not improve.

Summary: The effects of this alternative to old forest species are very similar to Alternative A, although the percent of single story dry upland old forest at year 50 would be even less at 8-12 percent, as compared to 9-15 percent. The desired condition for that potential vegetation group is 40-65 percent. The implementation of this alternative would likely result in relatively high or moderate viability outcomes for surrogate species associated with closed-canopy, multi-layered late-successional and old forest habitats, at least in the near term (less than 50 years). However,

this alternative would not improve the viability outcomes for surrogate species associated with more open-canopied old forest habitats within dry forests (white-headed woodpecker) because forest restoration treatments would only occur at a limited spatial scale. In addition, this alternative does not focus on landscape-scale forest restoration that has been identified as an important climate change adaptation to maintain old forest habitats in the long term (more than 50 years) (Lawler et al. 2014).

Alternative C

This alternative provides for the viability of old forest species through a system of Old Forest Management Areas (MA4C Old Forest) that encompass 451,900 acres across the Plan Area (Umatilla: 95,200 acres, Malheur: 205,400 acres, Wallowa-Whitman: 106,300 acres). This alternative limits active management in existing old forest areas, emphasizing short-term habitat protection for old forest species instead of active forest restoration and hazard fuels reduction (as in Alternatives E-Modified and E-Modified Departure). Under Alternative C, no commercial harvest would occur in old forest management areas (MA 4C) and only prescribed fire and treatment of smaller diameter trees for fuel reduction would be allowed.

The implementation of this alternative includes plan components for several key elements of old forest habitat. For instance, this alternative includes a standard to protect known cavity and nest trees, to protect all snags 21 inches diameter and larger, and retain 50 percent of snags 12 to 20 inches diameter. The plan components designed for goshawk would likely be beneficial to other species associated with large tree closed canopied forests.

The implementation of this alternative would decrease the negative effects of roads on old forest habitat. Desired Conditions for MA3C (Wildlife Corridor) would result in a road density of 1.0 mile per square mile on about 6.5 percent of the Umatilla National Forest, about 11 percent of the Malheur National Forest, and about 10 percent of the Wallowa-Whitman National Forest. Similar to Alternatives B, D, E, and F, Alternative C includes a standard that would prohibit new road and trail construction within existing old forest. This management direction would reduce road-associated risk factors to surrogate species such as displacement from key habitats, loss of snags for safety and firewood cutting, and fragmentation of old forest patches.

This alternative would result in moderate to high viability outcomes for surrogate species associated with closed-canopy, multi-layered late-successional and old forest habitats both within boreal forests (American marten, boreal owl) and moist forests (northern goshawk, pileated woodpecker) as it limits the use of mechanical treatments and active forest management. However, the percent of old forest for all potential vegetation groups on all three forests at year 50 would be 21-31 percent, compared to 23-34 percent as in Alternatives E-Modified and E-Modified Departure. That is likely because, under this alternative, the potential to use timber harvest as a tool to manage for old growth has been largely eliminated. Treatments would be confined to thinning trees less than 8 inches in diameter which would make it difficult to achieve desired stand densities and species composition in the majority of old forest stands. Higher stand densities would result in greater competition between trees and increased susceptibility to crown fire and insect outbreaks. Without the ability to use timber harvest, vegetation treatments would have to rely on prescribed fire and wildfire to reduce stand densities and alter species composition and forest structure. However, fire is an inexact tool and results are much less predictable than those of harvesting. Much of the dry upland forest potential vegetation group currently exists in closed stand densities and it would be unrealistic to expect to achieve low or mixed severity fire without first using a pretreatment of thinning or timber harvest. As a result, relying solely on the

effects of fire could lead to substantially higher levels of mortality across all age and size classes, including large and old trees.

This alternative would not improve the viability outcomes for surrogate species associated with more open-canopied old forest habitats within dry forests (white-headed woodpecker, western bluebird) because forest restoration treatments would only occur at a limited spatial scale. Forest restoration treatments (mechanical thinning and prescribed fire) that retain large trees and restore spatial heterogeneity have been shown to increase the presence and abundance of surrogate species associated with open-canopied old forest habitats within dry forests (Gaines et al. 2007, 2010).

Summary: The implementation of this alternative would result in moderate to high viability outcomes for surrogate species associated with closed-canopy, multi-layered late-successional and old forest habitats, at least in the near term (less than 50 years). However, this alternative would not improve the viability outcomes for surrogate species associated with more open-canopied old forest habitats within dry forests (white-headed woodpecker) because forest restoration treatments would only occur at a limited spatial scale. In addition, this alternative does not focus on landscape-scale forest restoration that has been identified as an important climate change adaptation to maintain old forest habitats in the long term (more than 50 years) (Lawler et al. 2014).

The greatest benefit to old forest surrogate species in this alternative is probably the reduction in road-related risks that would occur due to the lower road densities within wildlife corridors. However, this risk reduction would only occur on the 6.5-11 percent of the each forest that is designated as MA 3C.

Alternative D

Alternative D emphasizes active management using mechanical treatments rather than prescribed fire and has an increased area where motor vehicle use is suitable compared to other alternatives (Appendix A).

Habitat abundance for species associated with larger tree closed canopied forests declines to levels below those estimated for all other alternatives. The percent of old forest for all potential vegetation groups on all three forests at year 50 would be 20-30 percent, compared to 21-31 percent as in Alternative C and 23-34 percent as in E-Modified and E-Modified Departure. The difference in single story dry upland old forest at year 50 would be even greater under this alternative at 11-16 percent, as compared to 15-20 percent under Alternatives E-Modified and E-Modified Departure.

Because this alternative includes few plan components for several key elements of old forest habitat, both in open and closed-canopied habitats, these habitats are less likely to provide important habitat components such as large trees, snags, and overall habitat effectiveness. For example, this alternative does not include a specific land management area allocation for old forest and old forest would be included as lands designated as suitable for timber production. Most importantly, this is the only alternative that does not include any standards or guidelines related to the management of individual live large diameter or old trees.

Summary: The implementation of this alternative would improve the viability outcome for old forest surrogate wildlife species that are associated with open-canopy dry forest with large tree structure such as the white-headed woodpecker, although not as much as Alternatives E-Modified and E-Modified Departure would. This is likely because while this alternative schedules more

timber harvest, it does not focus the treatments on overstocked dry forest as intently as Alternatives E-Modified and E-Modified Departure. Viability outcomes for old forest surrogate species associated with closed-canopy multi-layered forests would likely be somewhat reduced but would remain within the historical range of variability. However, because this alternative includes few plan components for several key elements of open and closed old forest habitat, habitat effectiveness would be reduced.

Alternatives E and F

The main difference between Alternatives E and F is the amount of vegetation treatment. Alternative F involves approximately the same amount of vegetation treatment as Alternative B, but the other plan components, standards, guidelines, and management areas would be the same as Alternative E.

These alternatives are similar to Alternative D and provide fewer plan components for older forests, snags and large trees, although there is a guideline for protection of trees with older tree characteristics. Similar to Alternatives B, C, and D, there is a guideline to prohibit the construction of new motor vehicle routes in old forest stands. These alternatives also include fewer acres of land that are suitable for motor vehicle use than Alternatives A, B, D, E-Modified and E-Modified Departure. On the Umatilla and Wallowa-Whitman National Forests there are limited acres in MA 4C, Wildlife Corridor (21,600 acres Umatilla, 6,500 acres Wallowa-Whitman). Road densities are reduced in these areas (less than 1 mile per square mile), and vegetation treatments would retain at least 40 percent canopy cover.

Habitats for species associated with larger tree closed canopied forests decline less than Alternative D, but to a greater degree than Alternative B. Conversely, habitats for species associated with larger tree open-canopied forests increase more than Alternative B, but less than Alternative D, E-Modified and E-Modified Departure. The lack of plan components to protect important habitat features such as large snags, trees, and the potential for increased habitat fragmentation may lead to less effective habitat for species associated with old forest.

Summary: For all three forests, the implementation of these alternatives would improve the viability outcome for old forest surrogate wildlife species that are associated with open-canopy dry forest with large tree structure such as the white-headed woodpecker, but to a lesser extent than Alternatives E-Modified and E-Modified Departure because there would be less active restoration. The percent of dry upland forest old forest single story at year 50 would be 4-7 percent less than under Alternatives E-Modified and E-Modified Departure but 2-4 percent greater than under Alternative C. Viability outcomes for old forest surrogate species associated with closed-canopy multi-layered forests would likely be reduced, but would remain within the historical range of variability. However, because this alternative includes few plan components such as retention of large or old trees, for several key elements of old forest habitat, both in open and closed-canopied habitats, habitat effectiveness would be reduced.

Alternatives E-Modified and E-Modified Departure

The restoration approach that is emphasized in dry forests is described in desired conditions, which focus on moving landscape patterns and disturbance regimes toward their historical range of variability (Noss et al. 2006, Spies et al. 2006, Gaines et al. 2010a, Franklin and Johnson 2012). These alternatives would result in the greatest increase in open canopy old forest habitat in the dry upland forest at 50 years. In addition, by strategically locating restoration treatments, the

risk of loss of old forest habitat to uncharacteristically severe fires could be reduced (Finney 2001, Finney et al. 2006, Ager et al. 2007, Lehmkuhl et al. 2007).

For some old forest surrogate species, such as the white-headed woodpecker, conservation assessments have recommended the use of stand-level treatments to restore habitat because current habitat is well below historic levels (Wales et al. 2011, Mellen-McLean et al. 2013). Research on the effects of restoration treatments on birds has shown that treatments that retain large trees and promote within-stand structural variability can have positive effects on surrogate bird species, including the white-headed woodpecker and western bluebird (Gaines et al. 2007, Gaines et al. 2010). The implementation of these alternatives would result in the implementation of restorative treatments within dry forests, creating potentially favorable conditions for white-headed woodpeckers, improving their viability outcomes throughout the Plan Area and on each of the national forests.

For old forest surrogate species associated with closed-canopy, multi-layer forest conditions (e.g., American marten, northern goshawk, pileated woodpecker), viability outcomes would be reduced by forest harvest treatments occurring in this habitat. However, desired conditions based on the historical range of variability for closed-canopy, multi-layered forest habitats would result in viability outcomes that would be maintained at relatively high levels (Table 333 through Table 335) on the Umatilla National Forest, and at slightly lower levels on the Wallowa-Whitman National Forest.

The implementation of these alternatives includes plan components for several key elements of old forest habitat. For instance, desired conditions and guidelines for snag habitat (see Snag Associated Surrogate Species) state that snags should be managed within the historical range of variability in vegetation management treatments. Unlike Alternatives A, B, and C, this alternative does not explicitly prohibit the harvest of 21-inch trees. However, Alternatives E-Modified and E-Modified Departure do include a guideline for the retention and recruitment of old trees, large trees, and legacy trees, with some exceptions for insects, disease, fuel reduction, hazards, density management, and species composition.

These alternatives includes limited management direction that would reduce the effects of motorized access (see “Surrogate Species influenced by Motorized Access”) on surrogate wildlife species that are associated with old forest habitats.

Summary: Given the combination of vegetation treatments in dry upland forest and the guidelines for snags, old trees, and large trees, these two alternatives would likely provide the greatest contribution toward improving the viability outcome for old forest dependent surrogate wildlife species that are associated with open-canopy dry forest with large tree structure such as the white-headed woodpecker. Viability outcomes for old forest surrogate species associated with closed-canopy multi-layered forests would be somewhat reduced compared to other alternatives, but still maintained at relatively high levels (Table 333 through Table 335). The restoration approach emphasized in this alternative would create more resilient stands and landscapes, and could reduce the loss of old forest habitats to uncharacteristically severe wildfires. However, this alternative has limited emphasis on reducing the effects that roads have on old forest-associated surrogate wildlife species.

Direct and Indirect Effects – Motorized Access and Surrogate Wildlife Species

Motorized recreation and the use of forest roads influence the viability of surrogate wildlife species. These potential effects include displacement from key habitats, disturbance during

critical periods, and the risk of mortality caused by collisions with vehicles (see Wisdom et al. 2000 and Gaines et al. 2003 for a complete list of road and trail associated factors that influence wildlife). The effects of motorized access can occur year-round, including winter when snowmobiling or ski-trail grooming occurs.

The influence that roads currently have across the Plan Area is extensive. The road density outside of wilderness areas is 3.5 miles per square mile on the Umatilla, 4.2 miles per square mile on the Malheur, and 3.7 miles per square mile on the Wallowa-Whitman. High road densities reduce the viability outcomes for several surrogate wildlife species (Wales et al. 2011). Additionally, on the Malheur and Wallowa-Whitman, off-route motor vehicle traffic is not restricted except in select locations. Surrogate species that are particularly sensitive to motorized disturbance include wolverine, northern goshawk, American marten, bald eagle, and peregrine falcon. Effects specific to winter recreation were analyzed for the wolverine and bald eagle.

Alternative A – No Action

Implementation of this alternative would have limited opportunity to reduce the negative effects of roads on surrogate species habitat. The current management direction for roads is limited. Standards for road densities vary by management areas on the Malheur and the Wallowa-Whitman and off-route motor vehicle travel is generally allowed. Currently the Umatilla Forest Plan includes open road density in terms of a desired condition and off-route motor vehicle travel is limited to designated routes.

Road-associated risk factors to surrogate species such as displacement from key habitats, risk of mortality from collisions with vehicles, and disturbance during critical time periods would continue at current levels.

Overall, this alternative would provide a level of habitat effectiveness for surrogate species that is similar to B, D, E, F, and less than Alternatives C, E-Modified, and E-Modified Departure.

Summary: This alternative would make a relatively low contribution to the population viability of surrogate species that are sensitive to motorized disturbance. The alternative includes limited management direction to reduce the effects of roads on habitat effectiveness. This alternative does not alter the current effects that summer and winter motorized trails have on habitat effectiveness for surrogate wildlife species.

Alternative B

Open motor vehicle route density would change from a standard and/or guideline in Alternative A to a desired condition depending on the management area and winter elk habitat. General Forest (MA 4A) management would have a desired condition of an open route density of 2.4 miles per square mile. The desired condition for open motor vehicle route density in motorized backcountry management areas is 1.5 miles per square mile. Winter elk habitat also has a desired condition of 1.5 miles per square mile.

This alternative includes limited management direction to reduce the effects of existing motorized access on surrogate species and their habitats.

As compared to Alternative A, the area suitable for summer motor vehicle use would increase by about 7 percent on the Malheur and Umatilla National Forests, and change little on the Wallowa-Whitman National Forest. The area suitable for winter over-the-snow vehicle use decreases by less than 5 percent on all National Forests. Winter recreation is a risk factor for wolverine (Wales et al. 2011).

Alternative B includes a guideline that would prohibit new road and trail construction within existing old forest or high elevation riparian areas. This management direction would reduce road-associated risk factors to surrogate species such as displacement from key habitats, risk of mortality from collisions with vehicles, and disturbance during critical time periods.

Summary: The implementation of this alternative would make a relatively low contribution to the population viability of surrogate species that are sensitive to motorized disturbance because it includes limited management direction to reduce the effects of roads on habitat effectiveness. Similar to Alternative A, this alternative does not alter the current effects that summer and winter motorized trails have on habitat effectiveness for surrogate wildlife species.

Alternative C

The implementation of Alternative C would provide the greatest reduction in the effects of motorized access on surrogate wildlife species. Desired Conditions for MA3C (Wildlife Corridor) would result in road density of 1.0 mile per square mile on about 6.5 percent of the Umatilla National Forest, about 11 percent of the Malheur National Forest, and about 10 percent of the Wallowa-Whitman National Forest. Alternative C would reduce the area designated as suitable for summer motor vehicle use by 45 percent on the Umatilla, 38 percent on the Malheur, and 53 percent on the Wallowa-Whitman national forest compared to the current condition. In addition, Alternative C includes a standard that would prohibit new system road and trail construction within existing old forest or high elevation riparian areas. This management direction would reduce road-associated risk factors to surrogate species such as displacement from key habitats, risk of mortality from collisions with vehicles, and disturbance during critical time periods.

This alternative would also address risk-factors to surrogate wildlife species associated with winter motorized access such as the potential for displacement from key habitats or disturbance during critical time periods (such as wolverine denning). This alternative would reduce the amount of area suitable for winter motorized access by 30 percent on the Umatilla, 28 percent on the Malheur, and 38 percent on the Wallowa-Whitman national forests compared to the current condition. It does not designate any backcountry-motorized management areas and 505,000 acres are recommended for wilderness.

Summary: The implementation of Alternative C would make the greatest contribution to the viability outcomes for surrogate wildlife species influenced by risk factors associated with both summer and winter motorized access because the area suitable for motorized use would be much less than under other alternatives. However, the widespread influence of existing roads across the Plan Area would continue to limit the viability outcomes for some surrogate wildlife species (such as wolverine Table 333 through Table 335).

Alternative D

This alternative responds to requests for more public motor vehicle access. This alternative results in more areas suitable for summer and winter motor vehicle use compared to the other alternatives. In this alternative, the desired conditions for open motor vehicle route density in General Forest (MA-4A) is 3 miles per square mile or less.

As compared to Alternative A, the percent change in area suitable for summer motor vehicle use would increase by about 10 percent on the Malheur and Umatilla National Forests, and change little on the Wallowa-Whitman National Forest. The percent change in area suitable for winter motor vehicle use changes little.

Alternative D includes a guideline that would prohibit new road and trail construction within existing old forest or high elevation riparian areas.

Summary: The implementation of this alternative would make a relatively low contribution to the population viability of surrogate species that are sensitive to motorized disturbance because it provides more areas suitable for summer and winter motor vehicle use as well as higher open motor vehicle use compared to the other alternatives. Risks caused by motorized travel is highest in this alternative as compared to all other alternatives.

Alternatives E and F

The main difference between Alternatives E and F is the amount of vegetation treatment. There is no difference in the direction for motorized access between these alternatives, however the amount of human disturbance during restoration treatments will be greater in Alternative E, as acres treated per year is higher.

These alternatives includes limited management direction to reduce the effects of motorized access on surrogate species and their habitats. These alternatives contains no desired conditions for open-road densities in General Forest (MA-4A), although there are designated small amounts of wildlife corridor (MA 3C) linking high quality, unroaded wildlife habitats, which has a desired condition of open motor vehicle route density of less than 1 mile per square mile. However, the area in this management area is less than 22,000 acres on only the Umatilla National Forest and the Wallowa-Whitman National Forest combined.

As compared to the no action alternative, the percent change in area suitable for summer motor vehicle use would increase by about 8 percent on the Malheur National Forest and decrease by less than 10 percent on both the Umatilla and Wallowa-Whitman National Forests. For both these alternatives, the percent change in area suitable for winter over-the-snow vehicle use change little on the Malheur National Forest, and decrease by less than 10 percent on both the Umatilla and Wallowa-Whitman National Forests. Winter recreation is a risk factor for wolverine (Wales et al. 2011).

Alternatives E and F include guidelines that would prohibit new road and trail construction within existing old forest or high elevation riparian areas.

Summary: These alternatives includes limited management direction to reduce the effects of roads on habitat effectiveness for surrogate wildlife species. Risks caused by motorized travel in both these alternatives is likely similar to Alternatives A and B. Risk remains high as little change is expected in motorized travel as compared to the existing condition. On the Malheur, risks to surrogate species could actually increase due to the increase in area suitable for motor vehicle use.

Alternatives E-Modified and E-Modified Departure

These alternatives includes limited management direction to reduce the effects of motorized access on surrogate species and their habitats. Management direction for roads would include no net increase in road miles in key watersheds. The amount of area designated as suitable for summer motorized use would decrease by 2 percent on the Umatilla, increase by 5 percent on the Malheur, and decrease by 4 percent on the Wallowa-Whitman National Forest. The area suitable for winter-motorized access would be reduced by 7 percent on the Umatilla, 2 percent on the Malheur, and 5 percent on the Wallowa-Whitman National Forest.

This alternative includes a guideline to increase elk security in elk priority areas. We cannot estimate future road densities within elk priority areas but they will be reduced from the current condition to meet objectives for elk security. Exact locations of road closures would be determined by site-specific analyses and depend on other competing uses of the national forest and available funding.

Summary: These alternatives includes limited management direction to reduce the impact of motorized access on habitats for surrogate wildlife species. The widespread influence of existing roads across the Plan Area would continue. As a result, the risk factors associated with motorized access would continue to reduce the viability of some surrogate wildlife species (e.g., see wolverine, Table 333 through Table 335). However, these two alternatives would likely provide the second greatest contribution toward the population viability of surrogate species, after Alternative C, due to the amount of area suitable for summer and winter motor vehicle use and the incorporation of the elk priority areas.

Direct and Indirect Effects – Livestock Grazing and Surrogate Wildlife Species

Grazing can influence habitats of surrogate wildlife species by removing key habitat elements (such as dense shrubs for MacGillivray's warbler and fox sparrow), especially in riparian habitats, altering disturbance regimes that maintain habitat structure (like frequent fires in dry forests and grasslands keep open canopy for western bluebird), and influence the availability of important prey items (Wisdom et al. 2000, Gaines et al. 2017). To address the potential effects on surrogate wildlife species, the management direction regarding grazing in riparian habitat and upland habitats for each alternative was assessed. Surrogate wildlife species influenced by grazing include the ash-throated flycatcher, MacGillivray's warbler, Western bluebird, Cassin's finch, fox sparrow, lark sparrow, and northern harrier.

Alternative A – No Action

Alternative A would continue current Forest Plan direction as amended by PACFISH and INFISH requirements. This alternative has similar objective levels for numbers and locations of cattle and sheep as Alternatives B, E, and F, although utilization rates are higher.

Presently, some riparian habitats are in poor condition due to the effects of past and current grazing. The plan direction for this alternative would have little effect on altering the distribution of livestock that would allow riparian habitats to recover.

Summary: The implementation of this alternative would likely make a relatively low contribution to viability for surrogate wildlife species that are influenced by domestic grazing because it contains limited management direction for riparian habitat to reduce the negative effects of grazing and improve riparian habitat condition, and would not change the number, grazing intensity or distribution of livestock.

Alternative B

Implementation of alternative B would continue the trend towards improved rangeland vegetation conditions at about the same rate as Alternative A. This alternative is similar in objective levels for numbers and locations of cattle and sheep as Alternatives A, B, E, and F. Overall there will likely be a slow to moderate rate of progress toward achieving rangeland vegetation desired conditions. Alternative B would create a Guideline that grazing after wildland fire should be managed so as not to cause a trend away from the key species desired condition. In the long term, forage vigor and quality may be improved (RNG-1-G-43).

Grazing utilization guidelines in the riparian areas are less protective than Alternatives E-Modified or E-Modified Departure, which are using the 2018 Blue Mountains ARCS components. The 2018 Blue Mountains ARCS, which is applicable to these two additional alternatives, provides additional protection measures (GM-3G) in the riparian management areas as compared to all other alternatives.

Summary: Similar to Alternative A, the implementation of this alternative would likely make a relatively low contribution to viability for surrogate wildlife species that are influenced by domestic grazing because it contains limited management direction for riparian habitat to reduce the negative effects of grazing and improve riparian habitat condition, and would not change the number, grazing intensity or distribution of livestock.

Alternative C

The risk factors associated with grazing are widespread across the Plan Area and influence the viability outcomes for several surrogate wildlife species (Wales et al. 2011). This alternative would classify riparian habitats and subwatersheds with listed fish species as unsuitable for cattle grazing, benefiting riparian associated wildlife species. Presently, many riparian habitats are in poor to moderate condition due to the effects of past and current grazing. The plan direction for this alternative would make a considerable improvement on altering the distribution of livestock that would allow riparian habitats to recover.

Alternative C would reduce the number of cattle and sheep animal unit months from 37,800 to 4,200 for Umatilla National Forest, from 123,500 to 62,200 for Malheur National Forest, and from 81,500 to 29,500 for Wallowa-Whitman National Forest. This reduction in animal unit months is significantly greater than any of the other alternatives. In addition, this alternative would designate much fewer acres as suitable for grazing (43,000 acres for Umatilla; 675,000 acres for Malheur; 157,000 acres for Wallow-Whitman). This alternative reduces the risk factors associated with grazing and improves viability outcomes for surrogate wildlife species that are influenced by grazing, including those associated with grassland-shrubland habitats (Table 333 through Table 335), on each of the National Forests and across the Plan Area.

Alternative C proposes that grazing after wildland fire should be deferred until vegetation recovers to a condition where grazing will not cause the percent composition of native species to be reduced (cause a likely downward trend in key species) (RNG-1-G-43). This generally will be a minimum of 5 years, but could be up to 10 years depending on the extent and severity of the fire and other factors.

Summary: The risk factors associated with grazing are widespread across the Plan Area and influence the viability outcomes for several surrogate wildlife species (Wales et al. 2011; Appendix A). This alternative provides the greatest contribution toward reducing the risk factors associated with grazing and improves viability outcomes for surrogate wildlife species on each of the national forests and across the Plan Area due to the reduced acres suitable for grazing, the reduced animal unit months, and the post-fire rest requirements.

Alternative D - Livestock Grazing and Surrogate Wildlife Species

Alternative D would use desired conditions to address livestock grazing and rangeland vegetation rather than the standards and guidelines proposed for all other alternatives. Riparian management areas are the narrowest of all alternatives.

Acres suitable for grazing vary by national forest. On the Umatilla, the acreage would be slightly less for Alternative D than for Alternative A and the same as Alternatives B, E, E-Modified, E-Modified Departure, and F. On the Wallowa-Whitman, acres suitable for grazing would be greater for Alternative D than under Alternatives A, B, E, and F, but less than Alternatives E-Modified and E-Modified Departure. On the Malheur, the acreage suitable for grazing under Alternative D would be greater than Alternatives A, E, and F, but less than under Alternatives B, E-Modified, and E-Modified Departure.

Animal unit months would also vary by national forest. On the Umatilla, animal unit months under Alternative D would be similar to Alternatives A, B, E, and F, but less than Alternatives E-Modified, and E-Modified Departure. On the Wallowa-Whitman, animal unit months under Alternative D would be greater than Alternatives A, B, E, and F, but less than Alternatives E-Modified, and E-Modified Departure. Alternative D's projected rate of progress toward achieving rangeland vegetation desired condition is slow on the Malheur National Forest and moderate on the Umatilla and Wallowa-Whitman National Forests.

Grazing utilization guidelines in the riparian areas are less protective for Alternative D than for Alternative E-Modified or E-Modified Departure, which are using the 2018 Blue Mountains Aquatic and Riparian Conservation Strategy components.

Summary: The risk factors associated with grazing are widespread across the Plan Area and influence the viability outcomes for several surrogate wildlife species (Wales et al. 2011; Appendix A). This alternative would provide the least protective measure for surrogate wildlife species across the Plan Area. Even though this alternative has fewer acres identified as suitable for grazing and fewer animal unit months than Alternatives E-Modified and E-Modified Departure, the narrow riparian management areas and less protective grazing utilization guidelines would make it less effective in reducing the effects of grazing and creating more resilient landscapes than the other plan revision alternatives. This alternative does not reduce the risk factors associated with grazing and likely would not contribute to improving the viability outcomes for surrogate wildlife species on each of the national forests and across the Plan Area.

Alternatives E and F

These alternatives are similar in objective levels for numbers and locations of cattle and sheep as Alternatives A and B, although utilization rates in the uplands are more similar to E-Modified and E-Modified Departure. Alternatives E and F propose that grazing after wildland fire should be managed so as not to cause a trend away from the key species desired condition (RNG-1-G-43). This may include growing season deferment for one or more years following wildland fire.

Under Alternatives E and F, the rate of progress toward achieving rangeland vegetation desired condition is moderate on the Umatilla and Wallowa-Whitman. On the Malheur, the rate of progress is slow to moderate. This is a faster rate of recovery than under Alternatives A, B, and D, but slower than under Alternatives E-Modified, and E-Modified Departure. This is because grazing utilization guidelines in the riparian areas are less protective in Alternatives E and F than Alternative E-Modified or E-Modified Departure, which are using the 2018 Blue Mountains ARCS components.

Summary: The implementation of these alternatives would make a moderate contribution to viability for surrogate wildlife species that are influenced by domestic grazing. These alternatives would adjust livestock distribution and grazing intensity to protect unique habitats such as riparian areas and wetlands, and this alternative would include management direction that could

make habitats that are sensitive to the effects of climate change more resilient. However, the grazing utilization guidelines in the riparian areas are less protective than those of Alternative E-Modified or E-Modified Departure.

Alternatives E-Modified and E-Modified Departure

These alternatives includes ecologically based desired conditions for upland non-forest habitats (rangeland and alpine habitats) and guidelines to protect unique habitats. These alternatives would include an increase in the allowable animal unit months (49,200 for Umatilla; 133,200 for Malheur; 112,000 for Wallowa-Whitman) but would reduce the upland allowable forage utilization to 40 percent. These changes from the existing condition would improve the condition of grasslands, reducing the impacts of grazing on surrogate wildlife species associated with grassland-shrubland habitats.

These alternatives includes management direction for grazing in riparian habitats to improve riparian habitat condition. Presently, many riparian habitats are in poor to moderate condition due to the effects of past and current grazing. The plan direction would likely improve the viability outcomes for riparian-associated surrogate species whose habitats are influenced by grazing. The Blue Mountains Aquatic and Riparian Conservation Strategy (2018), as described in Alternatives E-Modified and E-Modified Departure, provides additional protection measures (e.g. GM-3G) in the riparian management areas as compared to all other alternatives.

Alternatives E-Modified and E-Modified Departure propose that grazing after wildland fire should be managed so as not to cause a trend away from the key species desired condition (Guideline LGRM-4G). This may include growing season deferment for one or more years following wildland fire.

Summary: The implementation of these alternatives would make a moderate contribution to viability for surrogate wildlife species that are influenced by domestic grazing. This determination is based on management direction for riparian habitats that would reduce the effects of grazing and improve riparian habitat condition. These alternatives would adjust livestock distribution and grazing intensity to protect unique habitats such as riparian areas and wetlands, and this alternative would include management direction that could make habitats that are sensitive to the effects of climate change more resilient. Although not as beneficial as Alternative C, these alternatives would provide greater benefit to surrogate wildlife species than other alternatives due to the additional riparian protection measures and the faster rate of progress toward achieving desired conditions.

Direct and Indirect Effects Snag Habitat Associated Surrogate Wildlife Species

Surrogate wildlife species associated with snag habitats include the pileated woodpecker, white-headed woodpecker, black-backed woodpecker, Lewis’s woodpecker, and western bluebird.

The availability of large snags (generally greater than 20 inches diameter) across the landscape has been reduced below historic levels by past management practices, especially within dry and mesic forests (Hessburg et al. 1999, Bate et al. 2007, Wisdom and Bate 2008, Hollenbeck et al. 2013).

Some forest activities directly influence the availability of habitat for snag-dependent surrogate species. These include firewood cutting (Bate et al. 2007, Hollenbeck et al. 2013), hazard tree reduction that causes the loss of snag habitat along roads and at recreation sites (Bate et al. 2007, Hollenbeck et al. 2013, Wisdom and Bate 2008), and removal of snags during timber harvest for

safety reasons (Wisdom and Bate 2008). In addition, the alteration of natural disturbance regimes can have considerable influence on the availability of snag habitat.

All alternatives have plan components for protection of known cavity or nest trees. Additionally, all alternatives except Alternative D have additional measures to protect bat maternity and roost sites, which may be snags.

Protection measures for prohibiting firewood collection in riparian management areas will maintain important habitat features for several surrogate species. The risk to larger snags (21 inches diameter and larger) from firewood harvest is currently ameliorated on all three national forests by restricting harvest to within 300 feet of a road and to snags less than 20 inches diameter per the firewood collection permit. Alternatives B, C, E, and F contain a standard to protect all snags 21 inches diameter and larger, including firewood collection. Alternatives D, E-Modified and E-Modified Departure contain no restrictions on snag size for firewood collection.

Post-fire snag protection measures would ensure some areas of each wildfire would be unharvested, and thus provide a diverse distribution of post-fire snag densities. Several studies have found that in recently burned forests, black-backed woodpecker nest sites were found at higher densities and had higher nest success in areas with high densities of standing snags, and unsalvaged areas (Haggard and Gaines 2001, Saab and Dudley 1998, Saab et al. 2009). Partially salvage-logged wildfires in Idaho contain fewer black-backed woodpecker nests but more Lewis's woodpecker nests than unlogged areas (Saab et al., 2002; Saab et al., 2004). Retaining larger snags during salvage will benefit species such as Lewis’s woodpecker and white-headed woodpeckers as these species are found to prefer larger snags for nesting. Additionally, many studies have found that larger diameter snags remain standing longer (Bull, 1983; Morrison and Raphael, 1993; Harrington, 1996; Ganey and Vojta, 2005)

Alternative A – No Action

The existing Forest Plan management direction for snag habitat to address the potential loss of habitat in timber sale operations was based on snag densities that more recent science has shown would not provide for viable populations of snag dependent species. This alternative includes a diameter limit on the size of snags cut for firewood as in Alternatives B, C, E, and F as there is a standard to protect all snags 21 inches diameter and larger.

Existing management plans provide limited opportunity to reduce the negative effects of roads on surrogate species habitats, such as the loss of snag habitat, because current management direction for roads is limited.

Summary: Overall, this alternative would provide habitat protections for snag dependent wildlife that remain below the historical capacity. The negative effects of roads on the loss of snag habitat would not be addressed. The viability outcomes for snag-dependent surrogate wildlife species would likely not be improved.

Alternative B

The implementation of this alternative includes a standard to protect known cavity and nest trees, all snags 21 inches diameter and larger, and retain 50 percent of snags 12-20 inches diameter. This standard would apply wherever mechanical treatments occur, including in post-fire timber harvest areas. This alternative contains a guideline to retain live old forest trees 21 inches diameter and larger with few exceptions. Protection of larger trees will provide more potential large snags in the future.

There are desired conditions for snag densities based on the historical range of variability, which are the same as described in Alternatives C, D, E, F. This alternative includes a diameter limit on the size of snags cut for firewood as in Alternatives A, C, E, and F as there is a standard to protect all snags 21 inches diameter and larger.

This alternative includes limited management direction to reduce the effects of motorized access on surrogate species and their habitats. Open motor vehicle route density would change from a standard and/or guideline in Alternative A to a desired condition depending on the management area. The guideline to prohibit new roads or trails within old forest stands will reduce the potential for loss of snags due to firewood removal and safety considerations.

Summary: Overall, this alternative would provide snag protections for snag dependent wildlife, although the negative effects of roads on the loss of snag habitat would not be addressed. The viability outcomes for snag-dependent surrogate wildlife species would likely be improved from Alternative A because snag densities would be based on the historical range of variability.

Alternative C

Alternative C includes a standard to protect known cavity and nest trees, to protect all snags 21 inches diameter and larger, and retain 50 percent of snags 12-20 inches diameter. This standard would apply wherever mechanical treatments occur, including in post-fire timber harvest areas. This alternative contains a standard to retain live old forest trees 21 inches diameter and larger, with few exceptions. Protection of larger trees will provide more potential large snags in the future.

Implementation of Alternative C would reduce the loss of snag habitat associated with roads. The area suitable for motor vehicle use is less than in any other alternative. Desired Conditions for MA3C (Wildlife Corridor) would result in road density of 1.0 mile per square mile on about 6.5 percent of the Umatilla National Forest, about 11 percent of the Malheur National Forest, and about 10 percent of the Wallowa-Whitman National Forest. In addition, Alternative C includes a standard that would prohibit new road and trail construction within existing old forest and high elevation riparian areas.

Summary: The implementation of Alternative C would provide management direction to retain all large snags and somewhat reduce the loss of snag habitat along roads by reducing road densities in some areas. This alternative would provide a relatively high contribution to the viability of snag-dependent surrogate wildlife species compared to the other alternatives because it protects known cavity and nest trees, all snags greater than 21 inches, and retains 50 percent of snags 12 to 20 inches in diameter, which is more snag retention than any other action alternative.

Alternative D

This alternative has no standard or guideline prohibiting the harvest of trees or snags greater than 21 inches diameter or trees with old forest characteristics. However, like Alternatives B, C, E, and F, there are desired conditions for snag densities based on the historical range of variability, which are the same as described in Alternatives C, D, E, and F.

All alternatives have plan components to protect of known cavity or nest trees, though this alternative does not have an additional guideline to protect bat maternity and roost sites, which may be snags.

This alternative includes the least management direction to reduce the effects of motorized access on surrogate species and their habitats. Bate et al. (2007) and Wisdom and Bate (2008), found that

snag numbers were lower adjacent to roads due to removal for safety considerations, removal as firewood, and other management activities (Bate et al. 2007, Wisdom and Bate (2008), Hollenbeck et al. 2013).

This alternative has no plan components in post-fire habitats. Salvage harvest will likely reduce habitat for species associated with post-fire habitat, especially those that prefer high densities of larger snags.

Summary: Overall, the risks to snags will likely be highest under Alternative D so this alternative would be least favorable for snag-dependent species. Surrogate species associated with snags may have reduced habitat quality across the plan area due to the higher road densities and fewer standards and guides that protect snags. The viability outcomes for snag-dependent surrogate wildlife species would likely not improve.

Alternatives E and F

Snag protection guidelines for mechanical treatment activities that occur within dry or cool moist forest habitat, retain all snags 21 inches diameter and larger and 50 percent of the snags from 12 to 21 inches diameter, except for the removal of danger/hazard trees. A similar guideline would also apply in post-fire habitats. This direction is similar to that of Alternatives B and C.

The desired conditions for snag densities based on the historical range of variability are the same as described in Alternatives C, D, E, and F. This alternative includes a diameter limit on the size of snags cut for firewood as in Alternatives A, B, and C as there is a standard to protect all snags 21 inches diameter and larger.

Under this alternative there are no standards or guidelines prohibiting the harvest of trees 21 inches diameter and larger, although there are guidelines to retain older trees (either addressed by age (Alternative F) or tree characteristics (Alternative E).

Summary: Overall, the effects of these alternatives on snag associated surrogate wildlife species will likely be similar to Alternative B because there are limited protection measures of large snags and trees during all vegetation management projects including salvage harvest and there is limited management direction to reduce the effects of motorized access on surrogate species and their habitats.

Alternatives E Modified and E-Modified Departure

Alternatives E Modified and E-Modified Departure include desired conditions and guidelines to restore the abundance and spatial arrangement of snags that are 10-20 inches diameter and larger than 20 inches diameter. The desired conditions are based on estimates of the range of variability for each habitat type (Mellen-McLean et al. 2009) applied at the landscape scale and commensurate with the disturbance regimes. Over time, these alternatives should restore large snags to their historic levels.

The desired conditions also set levels for snag habitat in post-fire landscapes. In addition, guidelines would limit post-fire salvage treatments in situations where desired conditions for post-fire habitats are not met, and limit post-fire salvage treatments to fire events larger than 100 acres (expect in some circumstances in the wildland urban interface). The implementation of this management direction should restore the abundance and spatial arrangement of habitat for snag-associated surrogate wildlife species and improve their viability outcomes.

Summary: Alternatives E-Modified and E-Modified Departure include management direction based on restoring the abundance and spatial arrangement of snag habitat based on estimated range of variability, including post-fire landscapes. These alternatives would focus on restoring disturbance regimes within dry forests that influence the availability and condition of snag habitat. However, these alternatives includes limited management direction that would reduce the loss of snag habitat associated with roads (Bate et al. 2007, Wisdom and Bate 2008, Hollenbeck et al. 2013), and has limited protection of large trees or snags. These alternatives should provide the greatest benefit to species associated with large snags in the long term because forest vegetation treatments will accelerate the development of large trees, which will eventually make large snags. However, these alternatives are probably less beneficial to species that use small snags than Alternative C, which having less harvest, would produce more competition, disease, and snags.

Direct and Indirect Effects – Riparian Associated Surrogate Wildlife Species

Forest activities that directly influence the quality and availability of habitat for riparian dependent surrogate species include management of roads, recreation sites, grazing, and vegetation treatments that occur within riparian habitats (Wisdom et al. 2000, Gaines et al. 2017).

Alternative B, similar to alternatives C, D, E, and F includes direction under the Blue Mountains Aquatic and Riparian Conservation Strategy (2008). This older Aquatic and Riparian Conservation Strategy, does not include as many protective measures for rangeland and riparian condition as the newer Strategy (2018) prescribed in the two additional alternatives, Alternatives E-Modified and E-Modified Departure.

Alternative A – No Action

The description of the PACFISH and INFISH riparian management objectives as described in Appendix A would be considered the desired conditions. These riparian conditions would remain similar to the desired conditions described in the 1990 Forest Plans.

In this alternative, management direction for watersheds and riparian habitats is not consolidated into one consistent set of plan components (that is, direction is in both the existing Forest Plan and in the PACFISH and INFISH amendment). Standards and guidelines would limit management activities allowed to occur within riparian habitats. This alternative includes smaller (compared to other alternatives except D) riparian management area widths along intermittent streams, lakes, and ponds.

The implementation of this alternative would not reduce the effects of roads on riparian habitats. Overall, this alternative would provide habitat protection for riparian associated wildlife that is similar to alternative D, but less than the other alternatives.

Conditions that contribute to viability of surrogate species would be maintained at levels below the historical capability and viability outcomes would not be considerably improved.

Summary: The implementation of this alternative would likely make a relatively low contribution to the viability of riparian dependent surrogate wildlife species. This alternative lacks effective and clear management direction to reduce the negative effects of roads on riparian habitat for surrogate wildlife species. More rigorous riparian management direction included in other alternatives (e.g., GM-3G in E-Modified), which better protects riparian habitats, would better address potential effects of climate change and cumulative effects.

Alternative B

This alternative proposes to manage riparian conditions through riparian management areas, identified as MA 4B. Similar to all plan revision alternatives there are several standards and guidelines that will protect and restore riparian habitats.

The riparian management area width would be the same as those used for riparian habitat conservation areas in key and priority watersheds for PACFISH and INFISH and would apply throughout the Plan Area. Habitats for fish species with management concerns (at-risk species) would be managed consistent with the 2008 Regional Aquatic Restoration and Conservation Strategy.

Within riparian management areas, the guideline for maximum percent utilization of both woody and herbaceous vegetation is 40 percent, which is the highest of all alternatives. Protection measure for prohibiting firewood collection in riparian management areas will maintain important habitat features for several wildlife species. Additionally, trees felled for safety in riparian management areas shall be retained onsite.

Summary: Overall, this alternative would provide habitat protection for riparian associated wildlife that is similar to alternatives E and F, but less than Alternatives E-Modified and E-Modified Departure. The viability outcome for surrogate wildlife species would likely improve, although not to the same degree as those alternatives with the 2018 Blue Mountains ARCS components.

Grazing utilization guidelines in the riparian areas are less protective than Alternative E-Modified or E-Modified Departure, which are using the 2018 Blue Mountains ARCS components. This alternative has limited management direction to reduce the impacts of roads on riparian habitats.

Alternative C

The influence of roads across the Plan Area is extensive and reduces the viability outcomes for several riparian habitat-associated surrogate wildlife species (Wales et al. 2011; Table 333 through Table 335). The implementation of this alternative would have the greatest reduction in the negative effects of roads on surrogate wildlife species. Desired Conditions for MA 3C (Wildlife Corridor) would result in road densities of 1.0 mile per square mile on about 6.5 percent of the Umatilla National Forest, about 11 percent of the Malheur National Forest, and about 10 percent of the Wallowa-Whitman National Forest. In addition, Alternative C includes a standard that would prohibit new road and trail construction within existing old forest and high elevation riparian habitats. This management direction would reduce road-associated risk factors to surrogate species such as displacement from key habitats, risk of mortality from collisions with vehicles, and disturbance during critical time periods.

The risk factors associated with grazing are widespread across the Plan Area and influence the viability outcomes for several riparian habitat-associated surrogate wildlife species (Wales et al. 2011; Table 333 through Table 335). Presently, many riparian habitats are in poor to moderate condition due to the effects of past and current grazing. Alternative C would reduce the number of cattle and sheep animal unit months (to 4,200 for Umatilla National Forest; 62,200 for Malheur National Forest; 29,500 for Wallowa-Whitman National Forest). This alternative would classify riparian habitats and subwatersheds with listed fish species as unsuitable for cattle grazing, benefiting riparian associated wildlife species. This alternative includes a relatively high amount of area (Umatilla 499,800 acres (36 percent), Malheur 368,000 acres (22 percent), Wallowa-Whitman 727,500 acres (40 percent)) designated as riparian management areas, where

management activities would emphasize restoration and maintenance of riparian and aquatic habitat objectives. This alternative reduces the risk factors associated with grazing and improves viability outcomes for riparian-associated surrogate wildlife species that are influenced by grazing (Table 333 through Table 335) on each of the national forests and across the Plan Area.

Summary: The influence that roads and grazing currently have across the Plan Area is widespread and reduces the viability outcomes for several riparian-associated surrogate wildlife species (Wales et al. 2011). Alternative C would reduce risk factors to riparian-associated wildlife species and include management direction to protect and restore riparian habitats. This would result in improvement in viability outcomes for riparian-associated surrogate species on each national forest and across the Plan Area (Table 333 through Table 335). This alternative would be most beneficial to riparian dependent species due to the decreased road densities, reduction in animal unit months and elimination of grazing in riparian habitats and subwatersheds with listed fish.

Alternative D

The approach to management of riparian conditions would be similar to Alternative B in that riparian management areas (MA 4B) would be designated where they occur within general forest (MA 4A), although these areas would be the narrowest of all alternatives and thus the area in MA 4B is the lowest of all alternatives.

Alternative D proposes higher utilization within riparian management areas as compared to other alternatives. Utilization in these riparian areas is up to 40 percent for both woody and deciduous vegetation. Additionally, with the exception of Alternatives E-Modified and E-Modified Departure, this alternative proposes the most animal unit months. The higher level of utilization and number of livestock will likely lead to a greater degree of herbivory and trampling within the riparian areas.

Summary: The implementation of this alternative would likely make a relatively low contribution to the viability of riparian dependent surrogate wildlife species. This alternative has the narrowest riparian management areas, which would reduce the protection and restoration of riparian habitats. Grazing utilization guidelines in the riparian areas are less protective than in Alternative E-Modified or E-Modified Departure, which are using the 2018 Blue Mountains Aquatic and Riparian Conservation Strategy components. This alternative has limited management direction to reduce the impacts of roads on riparian habitats. Additionally, this alternative would not emphasize landscape restoration that would reduce the potential effects of uncharacteristically severe fires on riparian habitats.

Alternatives E and F

These alternatives proposal for managing riparian conditions is the use of riparian management areas with the same desired conditions, standards and guidelines, and riparian management area widths proposed for Alternative B. Alternative F has guidelines for grazing utilization that are slightly less restrictive than Alternative E.

The 2008 Aquatic and Riparian Conservation Strategy in Alternatives E and F will provide protection for riparian habitats that would be stronger than alternative B with the addition of stricter livestock grazing utilization guidelines for most watersheds. However, this older strategy does not include as many protective measures for rangeland and riparian condition as the 2018 Blue Mountains ARCS prescribed in Alternatives E-Modified, and E-Modified Departure.

The maximum utilization for both woody and deciduous vegetation is prescribed at 25 percent within bull trout spawning and rearing reaches and 40 percent for all other watercourses including anadromous fish reaches. These utilization guidelines are in between Alternative B and C and similar to alternatives E-Modified and E-Modified Departure and would likely lead to improved habitats for riparian associated surrogate species.

Summary: These alternatives would likely enhance the viability outcomes for riparian-associated surrogate wildlife species, though likely less than Alternatives C, E-Modified and E-Modified Departure. Grazing utilization guidelines in the riparian areas are less protective than Alternatives E-Modified and E-Modified Departure, which are using the 2018 Blue Mountains Aquatic and Riparian Conservation Strategy components.

Alternatives E Modified and E-Modified Departure

These alternatives include an ecologically based strategy for aquatic and riparian ecosystems (Blue Mountains Aquatic and Riparian Conservation Strategy 2018) that addresses many of the risk factors that influence viability outcomes for riparian-associated surrogate wildlife species. This includes management direction for vegetation management, grazing, and roads. Vegetation management within riparian management areas (Umatilla 237,500 acres (17 percent), Malheur 192,900 acres (11 percent), and Wallowa-Whitman 360,100 acres (20 percent)) would emphasize the attainment of aquatic and riparian habitat objectives. This would maintain or restore riparian vegetation that provides key habitat for riparian-associated surrogate species.

These alternatives include management direction for grazing in riparian habitats to improve riparian habitat condition. Presently, many riparian habitats are in poor to moderate condition due to the effects of past and current grazing. The management direction under these alternatives would likely improve the viability outcomes for riparian-associated surrogate species whose habitats are influenced by grazing. The 2018 Blue Mountains ARCS also includes standards that road maintenance and new road construction shall be designed to minimize adverse effects to threatened, endangered, proposed, or candidate aquatic species and that riparian management areas include portions of watersheds where aquatic and riparian-dependent resources receive primary management emphasis. These standards will provide significant benefit to riparian species.

These alternatives include limited management direction to address the effects of motorized access on surrogate species habitats. Management direction for roads would include no net increase in road miles in key watersheds and a standard for no net loss of elk security. There would be reductions in road densities within elk priority areas. However, the exact amount and locations would depend on site-specific analyses. There are 39 key watersheds covering 570,000 acres on the Umatilla National Forest, 35 key watershed covering 563,800 acres on the Malheur National Forest, and 70 key watersheds covering 931,000 acres on the Wallowa-Whitman National Forest. The influence that roads currently have across the Plan Area is extensive and reduces the viability outcomes for several surrogate wildlife species (Wales et al. 2011; see wolverine Table 333 through Table 335).

Summary: These alternatives would enhance the viability outcomes for riparian-associated surrogate wildlife species. These alternatives would provide management direction so that vegetation management would emphasize the attainment of aquatic and riparian objectives. These alternatives includes management direction that would reduce the impacts of grazing and improve riparian habitat conditions. However, these alternatives have limited management direction to reduce the impacts of roads on riparian habitats. It is likely that Alternatives E-Modified and E-

Modified Departure would provide the greatest benefit to riparian species due to the inclusion of the 2018 Blue Mountains ARCS followed by Alternative C due to the reduced road densities and wider riparian buffers.

Climate Change and Surrogate Wildlife Species

The anticipated climatic changes to eastern Oregon environments are likely to result in a variety of effects to wildlife populations and their habitats (Stine et al. 2014, Halofsky and Peterson 2017). A striking conclusion reached from several climate change studies is the degree of change to wildlife habitats and populations that has already occurred (Lawler and Mathias 2007, Root et al. 2003). A variety of responses of wildlife to changing climatic conditions have occurred or are anticipated to occur including changes in species distributions, changes in the timing of breeding and other activities, changes in pathogens and invasive species distributions, changes in survival and extinction risks, and changes in the interactions among species (Gaines et al. 2012, Stine et al. 2014). To aid in the assessment of the effects of climate change and forest management activities on surrogate wildlife species the Climate Change Sensitivity Database (CCSD 2013) was used to determine the vulnerability of each species and the particular effects that climate change might have given their life history. The vulnerability ratings for the surrogate wildlife species assessed for the Blue Mountains plan revisions showed 11 (48 percent) are highly vulnerable to the effects of climate change, 10 (43 percent) have a moderate rating, and 2 (9 percent) have a low vulnerability rating (Table 332).

Climate Change and Old Forest Species

The sensitivity of old forest associated surrogate wildlife species to the effects of climate change were identified as medium for pileated woodpecker, and high for northern goshawk and American marten (CCSD 2013). The primary effect of climate change is likely to be the loss of old forest habitats due to altered disturbance regimes (CCSD 2013).

Since the mid-1980s, the size and intensity of large wildfires in the western United States have increased markedly (Westerling et al. 2006, Westerling 2016), due, in part, to a reduction in fuel moisture driven by increased temperature and lower snowpack. In the interior Columbia Basin, Littell et al. (2009) predicted that the area burned is likely to double or even triple by 2050. Climate-driven changes in fire regimes would likely be the dominant driver of changes to forests and old forest habitats in the western United States over the next century (McKenzie et al. 2004).

Challenges to habitat reserves can occur in ecosystems that are influenced by fire as research has shown that wildfires greatly influenced the amount and location of old-forest habitats across the landscape (Hessburg et al. 1999, 2007, 2015). In addition, as climate changes old forest associated species may need to adjust their ranges to find suitable climatic conditions and a static reserve network may not accommodate these movements (Araujo et al. 2004, Carroll et al. 2009, Carroll et al. 2010).

The forest restoration approach that is emphasized in dry forests in alternatives D, E, F, E-Modified, and E-Modified Departure represents the implementation of an adaptive strategy to create landscapes more resilient to climate change (Spies et al. 2010, Halofsky and Peterson 2017). Landscape-scale restoration has been identified as an adaptive strategy to maintain late-successional and old forest habitat structure (Lawler et al. 2014). The emphasis on restoration of resiliency would result in landscapes, including disturbance regimes, which are more resilient to climate change through the application of restoration treatments in priority locations (Noss et al. 2006, Spies et al. 2006, Gaines et al. 2010, Franklin and Johnson 2012). By strategically locating

restoration treatments, fire behavior can be altered to be more similar to native disturbance regimes and the risk of loss of old forest habitat to uncharacteristically severe fires can be reduced (Finney 2001, Finney et al. 2006, Ager et al. 2007, Lehmkuhl et al. 2007). In addition, implementation of these alternatives would include greater use of managed fire to achieve desired conditions for restoration and resiliency (Noss et al. 2006, Franklin and Johnson 2012). A landscape restoration approach is not emphasized in alternatives A, B, or C and these alternatives would result in a less resilient landscape than the other alternatives.

Table 332. Climate change vulnerability ratings for wildlife species assessed in the Blue Mountains Forest plan revision

Wildlife Species	Vulnerability Rating	Specific Climate Impacts
American marten	High	Changes to habitat distribution and amount
Ash-throated Flycatcher	Medium	Changes to habitat distribution and amount
Bald eagle	Low	Changes to fish populations
Black-backed Woodpecker	Medium	Changes to habitat from altered disturbance regimes
Boreal owl	High	Associated with habitat sensitive to climate change
Cassin's finch	High	Changes to extreme temperatures and dry air
Columbia spotted frog	High	Changes to wetland and riparian habitats
Fox sparrow	Medium	Changes to habitat distribution and amount
Lark sparrow	Medium	Changes to habitat distribution and amount
Lewis's woodpecker	Medium	Changes to habitat from altered disturbance regimes
Macgillivray's Warbler	Medium	Changes to habitat distribution and amount
Marsh wren	High	Riparian habitats high sensitivity to climate change
Northern goshawk	High	Changes to food supply and suitable habitat
Northern harrier	Medium	Changes in the distribution and amount of primary habitat
Peregrine falcon	Low	Generalist with high mobility
Pileated woodpecker	Medium	Loss of habitat due to altered disturbance regimes
Rocky Mountain tailed-frog	High	Loss of habitat, changes to stream temperatures
Sage thrasher	Medium	Changes in the distribution and amount of primary habitat
Water vole	High	Riparian habitats high sensitivity to climate change
Western bluebird	High	Changes to habitat from altered disturbance regimes. Changes from competition with other cavity nesters.
White-headed Woodpecker	Medium	Changes to habitat from altered disturbance regimes
Wilson's snipe	High	Riparian habitats high sensitivity to climate change
Wolverine	High	Changes in persistence of spring snow used for denning

Climate Change and Motorized Access Effects to Species

The sensitivity of surrogate wildlife species to climate change, and that were used to assess the effects of motorized access, is rated as low for the bald eagle, and high for the American marten, northern goshawk, and wolverine (Table 332 CCSD 2013). An important climate change adaptation that has been recommended for wildlife is to reduce the effects of roads on habitat to restore habitat resiliency to the effects of climate change (Gaines et al. 2012, Lawler et al. 2014, Dwire and Sabine Mellmann-Brown 2017). By reducing the negative effects of roads, habitats (especially riparian and wetland habitats) can become more resilient to the effects of climate change, and habitat connectivity can be restored allowing wildlife to adjust their ranges as conditions change.

The management direction for roads provided in Alternative C would provide the greatest reduction in motorized access related risk factors for surrogate species followed by alternatives E-Modified and E-Modified Departure. Alternatives B, E, and F include limited management direction to improve to habitat effectiveness for surrogate wildlife species by reducing road impacts and densities. Alternative A represent no change from the current condition and Alternative D would actually decrease habitat effectiveness relative to the existing condition.

Climate Change and Grazing Associated Species

Habitats that are particularly sensitive to the effects of climate change include riparian areas (including wetlands) and alpine areas (Lawler et al. 2014). A management adaptation to make these habitats more resilient to climate change is to reduce the effects of non-climatic stressors (such as roads, intense grazing, etc.)(Lawler et al. 2014).

Alternatives A, B, D, E, and F have limited management direction that would restore the resiliency of habitats that are sensitive to climate change. Alternative E-Modified and E-Modified Departure include management direction that would help to restore the resiliency of habitats that are sensitive to climate change. Alternative C would provide the greatest reduction in risk factors to surrogate wildlife species that are associated with grazing, making habitat more resilient to the impacts of climate change.

Climate Change and Snag Associated Species

Surrogate wildlife species associated with snag habitats include the pileated woodpecker, white-headed woodpecker, black-backed woodpecker, and Lewis's woodpecker and the western bluebird. The woodpecker species have a medium sensitivity rating to climate change, while the western bluebird has high sensitivity (Table 332, CCSD 2013). The primary effect anticipated from climate change is the loss of habitat due to altered disturbance regimes that result in uncharacteristically severe wildfires. The increase in fire associated with climate change could create a short-term gain in snag habitat followed by a long-term reduction (80-100 years, Harrod et al. 1998) as snag attrition occurs.

Because alternative A does not focus on landscape scale restoration, the restoration of disturbances regimes would not be emphasized. Thus, habitat for snag dependent surrogate wildlife is likely to be lost at an accelerated rate due to increased disturbances associated with climate change, loss of snag habitat from relatively intense timber harvest, and loss associated with roads as snags are cut for firewood and to reduce hazard trees. The increase in fire associated with climate change could create a short-term gain in snag habitat followed by a long-term reduction (80-100 years, Harrod et al. 1998) as snags attrition occurs.

Alternative B focuses on restoring landscapes, their functions and their processes and to create resilient landscapes that are adaptable to climate change. The rate of restoration treatments is similar to Alternative A, which leads to slow improvement in landscape resiliency. The restoration approach that is emphasized in Alternative B would occur more slowly than Alternatives D, E, E Modified, E-Modified Departure, and F for the dry forests. However, this alternative would result in stands, landscapes, and disturbance regimes that are closer to the historic range of variability and are more resilient to climate change than under Alternative A.

Alternative D has the highest rate of restoration treatments of all the alternatives. However, because there are few protection measures for snags and large trees, habitat for snag dependent surrogate wildlife is likely to be lost at an accelerated rate due to increased disturbances associated with climate change, loss of snag habitat from relatively intense timber harvest, and loss associated with roads as snags are cut for firewood and to reduce hazard trees. The increase in fire associated with climate change could create a short-term gain in snag habitat followed by a long-term reduction (80-100 years, Harrod et al. 1998) as snags attrition occurs.

The restoration approach that is emphasized for the dry forests in alternatives E, E-Modified, E-Modified Departure, and F would result in stands, landscapes, and disturbance regimes that are closer to the historic range of variability and are more resilient to climate change. In addition, these alternatives includes the use of managed fire to achieve desired conditions for landscape restoration and resiliency. Because forest disturbances such as fire, insects, and diseases directly influence the availability of snag habitat over time, restoration of disturbance regimes to mimic natural processes would aid in restoring snag habitat.

Climate Change and Riparian Associated Species

Many of the riparian associated surrogate species are rated as high sensitivity to climate change (CCSD 2013) and riparian habitats are considered vulnerable to the anticipated effects of climate change (Lawler et al. 2014,). The primary effect anticipated from climate change is the loss of habitat, reduced connectivity of riparian habitats due to altered hydrologic and disturbance (fire) regimes (Lawler et al. 2014, Dwire and Mellmann-Brown 2017), and increased water temperatures (Stine et al. 2014, Isaak et al. 2016).

The emphasis of Alternative A is on timber management. Because this alternative does not focus on landscape scale restoration, the restoration of disturbances regimes would not be emphasized. Thus, habitat for riparian dependent surrogate wildlife is likely to be lost at an accelerated rate due to increased disturbances associated with climate change and some loss of riparian habitat from timber harvest. In addition, an important adaptation for climate change for riparian habitats is to restore their resiliency by reducing the negative effects of roads (Lawler et al. 2014). However, this alternative has limited management direction to reduce road effects on riparian habitats and does not emphasize watershed restoration.

The management direction in Alternative B would emphasize the protection and restoration of riparian habitats by reducing the non-climate stressors and enhancing the resiliency of these habitats. However, this alternative has limited management direction to reduce road effects on riparian habitats.

Alternative C includes management direction to protect and restore riparian habitats that would increase their resiliency to the effects of climate change. In addition, this alternative would make the greatest contribution to reducing road-related effects to surrogate species.

The management direction in Alternative D would provide the narrowest riparian management areas, which would reduce the protection and restoration of riparian habitats. The emphasis of this alternative is on relatively intensive timber management. Because, this alternative does not focus on landscape scale restoration, the restoration of disturbances, habitat for riparian dependent surrogate wildlife is likely to be lost at an accelerated rate due to increased disturbances associated with climate change and some loss of riparian habitat from timber harvest. However, this alternative has limited management direction to reduce road effects on riparian habitats and does not emphasize watershed restoration.

The landscape restoration approach that is emphasized in Alternatives E and F would result in landscapes, including disturbance regimes that are more resilient to climate change, though important riparian habitat protection measures are not included (e.g. GM-3G). However, these alternatives have limited management direction to reduce road effects on riparian habitats.

The management direction in Alternatives E-Modified and E-Modified Departure would emphasize the protection and restoration of riparian habitats by reducing the non-climate stressors and enhancing the resiliency of these habitats. These alternatives would make some progress toward reducing road effects on riparian habitats, albeit less than Alternative C.

Summary for Surrogate Species

For the 23 species modeled for the existing condition within the Umatilla and Wallowa-Whitman National Forests (see Table 334 and Table 335), and the 22 species modeled for the Malheur National Forest (see Table 333), the lack of open late old structure, especially in ponderosa pine, and the lack of early successional stages were identified as habitats of concern. Both have also been identified in the literature as concerns.

Environmental outcomes defined in Raphael et al. (2001) were used as a basis to describe five viability outcomes. These outcomes were calculated for current and historical conditions for each surrogate species to assess changes in habitat conditions. The term “suitable environment” refers to a combination of source habitat and risk factors that influence the probability of occupancy and demographic performance of a surrogate species. The viability outcomes are based on departure from historical conditions. The five viability outcomes we used were:

1. **Outcome A**—Suitable environments are broadly distributed across the historical range of the species throughout the assessment area. Habitat abundance is high relative to historical conditions. The combination of distribution and abundance of environmental conditions provides opportunity for continuous or nearly continuous intraspecific interactions for the surrogate species.

2. **Outcome B**—Suitable environments are broadly distributed across the historical range of the species. Suitable environments are of moderate to high abundance relative to historical conditions, but there may be gaps where suitable environments are absent or present in low abundance. However, any disjunctive areas of suitable environments are typically large enough and close enough to permit dispersal among subpopulations and to allow the species to potentially interact as a metapopulation. Species with this outcome are likely well distributed throughout most of the assessment area.

3. **Outcome C**—Suitable environments moderately distributed across the historical range of the species. Suitable environments exist at moderate abundance relative to historical conditions. Gaps where suitable environments are either absent or present in low abundance are large enough such that some subpopulations may be isolated, limiting opportunity for intraspecific

interactions especially for species with limited dispersal ability. For species for which this is not the historical condition, reduction in the species' range in the assessment area may have resulted. Surrogate species with this outcome are likely well distributed in only a portion of the assessment area.

4. **Outcome D**—Suitable environments are low to moderately distributed across the historical range of the species. Suitable environments exist at low abundance relative to their historical conditions. While some of the subpopulations associated with these environments may be self-sustaining, there is limited opportunity for population interactions among many of the suitable environmental patches for species with limited dispersal ability. For species for which this is not the historical condition, reduction in species' range in the assessment area may have resulted. These species may not be well distributed across the assessment area.

5. **Outcome E**—Suitable environments are highly isolated and exist at very low abundance relative to historical conditions. Suitable environments are not well distributed across the historical range of the species. For species with limited dispersal ability there may be little or no possibility of population interactions among suitable environmental patches, resulting in potential for extirpations within many of the patches, and little likelihood of recolonization of such patches. There has likely been a reduction in the species' range from historical conditions, except for some rare, local endemics that may have persisted in this condition since the historical period. Surrogate species with this outcome are not well distributed throughout much of the assessment area.

Although it is anticipated that all species would remain viable for any of the alternatives, some alternatives show a higher likelihood for improved species viability than others. The following tables are intended to display the relative ranking of each alternative in addressing the viability concerns of the representative surrogate species.

Of the species that are highly departed from historic conditions, three of the species are associated with either early successional or more open habitats. Both of these habitat distributions are generally below what would be expected on the landscape. Swanson et al. (2010) called it the forgotten stage of forest succession and it has been identified by some as important in the conservation of bird species (DeGraaf and Yamasaki 2003, Fontaine et al. 2009). Both of these habitats would be created at higher levels for Alternatives D, E, E-Modified, and E-Modified Departure. These same three species are also all affected by grazing associated changes in vegetative structure. The threat from grazing would be greatest from Alternative D based on more acres being available for grazing, while the threat from the level of vegetative structure alteration would be greatest from Alternatives A and B.

Table 333. Viability outcomes for surrogate wildlife species assessed on the Malheur National Forest in short (less than 20 years) and long (less than 50 years) time periods. Current and historical outcomes were not modeled over time.

Surrogate Wildlife Species[1]	Time period	Historical	Current	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. E-Mod.	Alt. E-Mod. Dep.	Alt. F
American Marten	Short	B/C	D/E	C	C	D	D	C	D	D	D
American Marten	Long	No data	No data	C	C	C	C	C	C/D	C	C
Ash-throated Flycatcher	Short	A	D	D	D	D	D	D	D	D	D
Ash-throated Flycatcher	Long	No data	No data	D	C	D	D	D	D	D	D
Bald Eagle	Short	A	B	B	A/B	B	B	B	B	B	B
Bald Eagle	Long	No data	No data	B	A/B	B	B	B	B	B	B
Black-backed Woodpecker	Short	A	C	C	B/C	C	C	C	C	C	C
Black-backed Woodpecker	Long	No data	No data	C	B	C	C	C	C	C	C
Boreal Owl	Short	B	E	C	D	C	C	C	D	C/D	C/D
Boreal Owl	Long	No data	No data	C	D	B	B	C	D	C	C/D
Cassin's Finch	Short	A	D	C	C	C	C	C	C	C	C
Cassin's Finch	Long	No data	No data	C	C	B	B	B/C	B/C	B	B
Columbia Spotted Frog	Short	A	C	C	C	C	C	C	C	C	C
Columbia Spotted Frog	Long	No data	No data	C	B	C	C	C	C	C	C
Fox Sparrow	Short	A	D	D	D	D	D	D	D	D	D
Fox Sparrow	Long	No data	No data	C	C	C	C	C	C	C	C
Lark Sparrow	Short	B	B	B	B	B	B	B	B	B	B
Lark Sparrow	Long	No data	No data	B	B	B	B	B	B	B	B
Lewis's Woodpecker	Short	A	C/D	C/D	C	C/D	C/D	C/D	C/D	C/D	C/D
Lewis's Woodpecker	Long	No data	No data	C/D	B/C	C	C	C	C	C	C
MacGillivray's Warbler	Short	A	C	C	C	C	C	C	C	C	C
MacGillivray's Warbler	Long	No data	No data	C	B	C	C	C	C	C	C
Marsh Wren	Short	A	B	B	B	B	B	B	B	B	B
Marsh Wren	Long	No data	No data	B	B	B	B	B	B	B	B
Northern Goshawk	Short	A	A	A	A	B	B	A	B	B	B
Northern Goshawk	Long	No data	No data	A	A	B	B	A	B	B	B
Northern Harrier	Short	A	B	B	A/B	B	B	B	B	B	B

Surrogate Wildlife Species[1]	Time period	Historical	Current	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. E-Mod.	Alt. E-Mod. Dep.	Alt. F
Northern Harrier	Long	No data	No data	B	A	B	B	B	B	B	B
Pileated Woodpecker	Short	A	A	A	A	A	A	A	A/B	A	Alt F
Pileated Woodpecker	Long	No data	No data	B	A	B	B	B	B	B	B
Sage Thrasher	Short	B	C	C	C	C	C	C	C	C	C
Sage Thrasher	Long	No data	No data	C	B	C	C	C	C	C	C
Water Vole	Short	A	B	B	B	B	B	B	B	B	B
Water Vole	Long	No data	No data	B	A	B	B	B	B	B	B
Western Bluebird	Short	A	D	D	D	C/D	C/D	D	D	C/D	D
Western Bluebird	Long	No data	No data	D	D	C	C	D	C/D	C/D	D
White-headed Woodpecker	Short	A	E	E	E	E	E	E	E	E	E
White-headed Woodpecker	Long	No data	No data	E	E	D	D	E	E	D	D
Wilson's Snipe	Short	A	B	B	B	B	B	B	B	B	B
Wilson's Snipe	Long	No data	No data	B	B	B	B	B	B	B	B
Wolverine	Short	A	E	E	E	E	E	E	E	E	E
Wolverine	Long	No data	No data	E	D	E	E	E	E	E	E

1. Rocky Mountain tailed-frog not present on the National Forest. Peregrine falcon not assessed due to limited habitat..

Table 334. Viability outcomes for surrogate wildlife species assessed on the Umatilla National Forest in short (less than 20 years) and long (less than 50 years) time periods

Surrogate Wildlife Species	Time period	Historical	Current	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. E-Mod.	Alt. E-Mod. Dep.	Alt. F
American Marten	Short	A	A	A	A	A	A/B	A	A	A	A
American Marten	Long	No data	No data	A	A/B	A	A/B	A	A	A	A
Ash-throated Flycatcher	Short	A	D	D	D	D	D	D	D	D	D
Ash-throated Flycatcher	Long	No data	No data	D	D	C	D	D	D	D	D
Bald Eagle	Short	B	C	C	C	C	C	C	C	C	C
Bald Eagle	Long	No data	No data	C	C	C	C	C	C	C	C
Black-backed Woodpecker	Short	A	C	C	C	C	C	C	C	C	C
Black-backed Woodpecker	Long	No data	No data	C	C	C	C	C	C	C	C
Boreal Owl	Short	A	C	C	C	C	C/D	C	C	C	C

Surrogate Wildlife Species	Time period	Historical	Current	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. E-Mod.	Alt. E-Mod. Dep.	Alt. F
Boreal Owl	Long	No data	No data	C	C	C	C/D	C	C	C	C
Cassin's Finch	Short	A	C/D	C	C	C	C	C	C	C	C
Cassin's Finch	Long	No data	No data	C	C	C	B	B	B	B	B
Columbia Spotted Frog	Short	A	C	C	C	C	B/C	C	C	C	C
Columbia Spotted Frog	Long	No data	No data	C	C	B	B/C	C	C	C	C
Fox Sparrow	Short	A	C	C	C	C	C	C	C	C	C
Fox Sparrow	Long	No data	No data	C	C	C	C	C	C	C	C
Lark Sparrow	Short	B	B	B	B	B	B	B	B	B	B
Lark Sparrow	Long	No data	No data	B	B	B	B	B	B	B	B
Lewis's Woodpecker	Short	A	C	C	C	C	C	C	C	C	C
Lewis's Woodpecker	Long	No data	No data	C	C	C	C	C	B	B	C
MacGillivray's Warbler	Short	A	C	C	C	C	C	C	C	C	C
MacGillivray's Warbler	Long	No data	No data	C	C	B	C	C	C	C	C
Marsh Wren	Short	A	B	B	B	B	B	B	B	B	B
Marsh Wren	Long	No data	No data	B	B	B	B	B	B	B	B
Northern Goshawk	Short	A	A	A	A	A	A	A	A	A	A
Northern Goshawk	Long	No data	No data	A	A	A	B	A	A	A	A
Northern Harrier	Short	A	B	B	B	A/B	B	B	B	B	B
Northern Harrier	Long	No data	No data	B	B	A/B	B	B	B	B	B
Peregrine Falcon	Short	B	B/C	B/C	B/C	B/C	B/C	B/C	B/C	B/C	B/C
Peregrine Falcon	Long	No data	No data	B/C	B/C	B/C	B/C	B/C	B/C	B/C	B/C
Pileated Woodpecker	Short	A	B	B	A	B	B	B	B	B	B
Pileated Woodpecker	Long	No data	No data	B	B	B	B	B	B	B	B
Rocky Mountain Tailed-frog	Short	A	B	B	B	B	B	B	B	B	B
Rocky Mountain Tailed-frog	Long	No data	No data	B	B	B	B	B	B	B	B
Sage Thrasher	Short	B	C	C	C	C	C	C	C	C	C
Sage Thrasher	Long	No data	No data	C	C	C	C	C	C	C	C
Water Vole	Short	A	B	B	B	B	B	B	B	B	B
Water Vole	Long	No data	No data	B	B	A	B	B	B	B	B

Surrogate Wildlife Species	Time period	Historical	Current	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. E-Mod.	Alt. E-Mod. Dep.	Alt. F
Western Bluebird	Short	A	D	D	D	D	D	C/D	C/D	C/D	D
Western Bluebird	Long	No data	No data	C	C	D	C	C	C	C	C
White-headed Woodpecker	Short	A	E	E	E	E	E	E	E	E	E
White-headed Woodpecker	Long	No data	No data	E	E	E	E	E	D	D	E
Wilson's Snipe	Short	A	B	B	B	B	B	B	B	B	B
Wilson's Snipe	Long	No data	No data	B	B	B	B	B	B	B	B
Wolverine	Short	B	C/D	C/D	C/D	C/D	C/D	C/D	C/D	C/D	C/D
Wolverine	Long	No data	No data	C/D	C/D	C/D	C/D	C/D	C/D	C/D	C/D

Table 335. Viability outcomes for surrogate wildlife species assessed on the Wallowa-Whitman National Forest in short (less than 20 years) and long (less than 50 years) time periods

Surrogate Wildlife Species[1]	Time period	Historical	Current	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. E-Mod.	Alt. E-Mod. Dep.	Alt. F
American Marten	Short	A	B	B	B	B	B	B	B	B	B
American Marten	Long	No data	No data	C	C	B	C/D	C	C	C	C
Bald Eagle	Short	B	C	C	C	B/C	C	C	C	C	C
Bald Eagle	Long	No data	No data	C	C	B/C	C	C	C	C	C
Black-backed Woodpecker	Short	A	B	B	C	C	B	B	B	B	B
Black-backed Woodpecker	Long	No data	No data	B	C	B/C	B/C	B/C	B/C	B/C	B/C
Boreal Owl	Short	A	C	C	C	C	C/D	C	C	C	C
Boreal Owl	Long	No data	No data	B	B	C	C/D	B	B	B	B
Cassin's Finch	Short	A	D	D	D	C	D	C/D	C	C	C/D
Cassin's Finch	Long	No data	No data	C	C	C	C/D	C	B	B	C
Columbia Spotted Frog	Short	A	B	B	B	B	B/C	B	B	B	B
Columbia Spotted Frog	Long	No data	No data	B	B	A/B	B/C	B	B	B	B
Fox Sparrow	Short	A	C	C	C	C	C	C	C	C	C
Fox Sparrow	Long	No data	No data	C	C	C	C	C	C	C	C
Lark Sparrow	Short	A	A	A	A	A	A	A	A	A	A
Lark Sparrow	Long	No data	No data	A	A	A	A	A	A	A	A
Lewis's Woodpecker	Short	A	C	C	C	C	C	C	C	C	C

Surrogate Wildlife Species[1]	Time period	Historical	Current	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. E-Mod.	Alt. E-Mod. Dep.	Alt. F
Lewis's Woodpecker	Long	No data	No data	C	C	C	C	C	B	B	C
MacGillivray's Warbler	Short	A	C	C	C	C	C	C	C	C	C
MacGillivray's Warbler	Long	No data	No data	C	C	B	C	C	C	C	C
Marsh Wren	Short	A	B	B	B	B	B	B	B	B	B
Marsh Wren	Long	No data	No data	B	B	B	B	B	B	B	B
Northern Goshawk	Short	A	A	A	A	A	B	B	B	B	B
Northern Goshawk	Long	No data	No data	A	A	A	C	B	B	B	B
Northern Harrier	Short	A	B	B	B	A/B	B	B	B	B	B
Northern Harrier	Long	No data	No data	B	B	A	B	B	B	B	B
Peregrine Falcon	Short	B	B/C	B/C	B/C	B/C	B/C	B/C	B/C	B/C	B/C
Peregrine Falcon	Long	No data	No data	B/C	B/C	B	B/C	B/C	B/C	B/C	B/C
Pileated Woodpecker	Short	A	C	C	C	C	C	C	C	C	C
Pileated Woodpecker	Long	No data	No data	C	C	C	C	C	C	C	C
Rocky Mountain Tailed-frog	Short	A	C	C	C	C	C/D	C	C	C	C
Rocky Mountain Tailed-frog	Long	No data	No data	C	C	B	C	C	C	C	C
Sage Thrasher	Short	B	C	C	C	C	C	C	C	C	C
Sage Thrasher	Long	No data	No data	C	C	B	C	C	C	C	C
Water Vole	Short	A	A	A	A	A	A	A	A	A	A
Water Vole	Long	No data	No data	A	A	A	A	A	A	A	A
Western Bluebird	Short	A	D	D	D	D	D	C/D	C/D	C/D	D
Western Bluebird	Long	No data	No data	D	D	D	C/D	C/D	C	C	C/D
White-headed Woodpecker	Short	A	E	E	E	E	E	E	E	E	E
White-headed Woodpecker	Long	No data	No data	E	E	E	E	D	D	D	D
Wilson's Snipe	Short	A	B	B	B	B	B	B	B	B	B
Wilson's Snipe	Long	No data	No data	B	B	B	B	B	B	B	B
Wolverine	Short	A	D	D	D	D	D	D	D	D	D
Wolverine	Long	No data	No data	D	D	C	D	D	D	D	D

1. The ash-throated flycatcher was not assessed due to very limited habitat on the National Forest.

It is uncertain if there is a level of upland grazing that would still allow adequate vegetative structure for these three species. For example, Saab et al. (1995) reported that Cassin's finch responded negatively to heavy grazing and showed no response to moderate grazing. They also reported that the fox sparrow responded negatively to heavy and variable grazing. The studies used for both species referred to riparian habitats. Holechek et al. (1999) found confusion exists, even among range professionals, as to what heavy and moderate grazing intensity mean and that heavy grazing, as reported in the stocking studies they reviewed, averaged 57 percent utilization of primary forage species and that moderate averaged 43 percent. However, when using the best explanation of these terms (as given by Klipple and Bement, 1961) moderate grazing in coniferous forest rangelands was between 35 and 45 percent of forage (ibid).

Large snags are important to several species. Past management may have led to a reduction of snags and it will take time to replace them on the landscape, but the mechanism to do so for Forest Service management activities is in place for all alternatives. Open motor vehicle route density was also considered a threat to snag retention, mostly associated with the harvest of snags for firewood. Currently, there is a restriction on the removal of large-diameter snags for personal firewood use. However, it is recognized that large-diameter snags near open motor vehicle routes would continue to be vulnerable to illegal firewood removal, resulting in a loss of current snags and of future large-diameter logs. The loss of this habitat component would be most prevalent in areas with high open motor vehicle route densities. As such, Alternative C would have the lowest risk to roadside snag densities, followed by Alternatives E Modified and E-Modified Departure.

Management direction designed to achieve desired vegetative conditions in the Forest Plan is intended to result in long-term terrestrial wildlife source habitat conditions within the predicted historical range of variability. The rationale for using historical range of variability for this purpose is that biodiversity is assumed to persist, albeit with fluctuations in populations, through centuries or millennia of disturbance and recovery (Aplet and Keeton 1999). Even with the predictions of climate change, historical range of variability presents the greatest potential to respond to expected change. Approximating historical conditions for source habitats provide a management strategy likely to sustain diverse focal species, even for those about which we know little (Hunter et al. 1988, Landres et al. 1999, Swanson et al. 1994). Similarly, because of limited understanding about ecosystems, approximating past conditions offers one of the best means for predicting and reducing impacts to current ecosystems (Kaufmann et al. 1994). Therefore, if the amount and structure of source habitats are within their historical range of variability, associated wildlife species will have a greater likelihood of sustainability than if the amount and structure of source habitats remain outside their historical range of variability (Raphael et al. 2001, Spies et al. 2006).

Based on the analysis, it appears unlikely that changes in threats are of sufficient magnitude to override the importance of source habitat in determining species viability. Although a slight reduction in source habitat for some of these species occurs, especially for Alternatives A and C, by the end of the fifth decade, the trend in source habitat is either stable or upward. There is a large degree of uncertainty however, especially for the three open habitat species, and therefore all plan revision alternatives should require monitoring of both habitat and risk factors over time. Since the pileated woodpecker and white-headed woodpecker are focal species, monitoring are required for these species. The boreal owl (Umatilla only), western bluebird, Cassin's finch, and fox sparrow will be monitored for trends in source habitat and risk factors.

Surrogate Species Not Modeled

Approximately half of the species modeled for current viability outcomes were not modeled for Alternative B, since it was determined that a reliable way to project and quantify future changes did not exist (Wales et al. 2011). For example, several species were associated with very limited habitat on National Forest System lands (e.g., northern harrier) or habitats that had little active management within them (ash-throated flycatcher). There also was a group of species that were not modeled for existing conditions. Although it was not possible to model viability, a qualitative analysis of forest plan components (desired conditions and standards and guidelines) for the alternatives indicated they would be sufficient to reduce threats and improve habitat for most of these species, thereby improving the likelihood of continued viability for all of the alternatives. For example, species associated with riparian areas would receive protection based on the desired conditions for aquatic habitat and watershed function (see Appendix A 1.1 Watershed Function), which describe a desire for continued improvement in abundance and quality of riparian areas. Standard and guidelines also would provide protection (for a complete list see Wales et al. 2011)

Detailed analysis of all these species for Alternative B is available in Wales et al. (2011). None of the species in this group that initially had viability concerns would be expected to have increased concern because of implementing Alternative B (Wales et al. 2011). Since none of the other alternatives differ substantially from alternative B regarding risk to or loss of habitat for these species, they have not been analyzed further.

Threatened, Endangered, Proposed, Candidate, and Sensitive Wildlife Species

Special management emphasis is given to species for which there is a documented viability concern. Species listed in compliance with the Endangered Species Act are placed in one of four categories based on viability concerns: threatened, endangered, proposed, and candidate. The Forest Service has a legal requirement to maintain or improve habitat conditions for these federally listed species to comply with the Endangered Species Act. Currently, there are two threatened and endangered terrestrial wildlife species (Canada lynx and gray wolf) and one species that is currently proposed for listing (wolverine) that either occur or have habitat present within the Plan Area. Threatened and endangered species are of particular concern because of their status and their need for special management attention.

Projects implemented under the Forest Plan collect more site-specific resource information for the project area. Biological evaluations and assessments that provide detailed analysis of potential effects from each project are required for threatened, endangered, proposed, and candidate species and those included on the Regional Forester’s Sensitive Species List. Historical conditions, current conditions and desired conditions are analyzed at a finer scale of resolution to better predict project outcomes. A determination of effects for these species would have to be made for any future project under the direction of the Forest Plan.

As indicated in the “Surrogate Species” section, a basic assumption is that the surrogate species represent ecological conditions that provide for viability of other species in the group and that surrogate species represent the species group (see Table 329) such that, by providing for adequate amounts and distribution of habitat and managing risks for surrogate species, the ecological conditions needed to maintain viability of other associated species would be provided (USDA Forest Service 2010). Some species were analyzed in detail as surrogate species in the viability assessment (Wales et al. 2011). Although some of these surrogate species had low viability scores, there was no indication that implementing any of the alternatives would threaten the viability of any of those species to the extent that would cause a trend towards Federal listing.

What follows is a description of the broad potential effects at the national forest level for species currently listed in compliance with the Endangered Species Act within the Plan Area. In some cases, standards and guidelines have been included to improve safeguards for certain habitat features of some species. All alternatives assume that direction given in Forest Service Manual 2670 and Handbook 2609 will be followed.[10] While the surrogate species analysis addressed viability for all species in the Plan Area, some additional information on specific species has been added below.

Canada Lynx

The Canada lynx was listed as a threatened species in March 2000 (USFWS 2000). Critical habitat was designated in November 2006, and then was revised in 2009 (USFWS 2009). A recovery plan has not been published; although a Recovery Outline (USDI 2005) was released in September of 2005 (Recovery Outlines carry no regulatory authority). This outline identified northeast Oregon/southeast Washington as peripheral areas defined as areas that contain few verified historical or recent records of lynx. Records are sporadic and usually associated with periods when there were unprecedented cyclic population highs in Canada, such as the early to mid-1960s and/or 1970s. There is no evidence of long-term presence or reproduction that might indicate colonization or sustained use of these areas by lynx. However, some of these peripheral areas may provide habitat enabling the successful dispersal of lynx between populations or subpopulations. At this time, we simply do not have enough information to clearly define the relative importance of secondary or peripheral areas to the persistence of lynx in the contiguous United States (USDI 2005).

Due to a lack of data, the historical and current status of resident lynx populations in the Blue Mountains is uncertain. Only nine museum specimens exist for Oregon- all from 1897-1927 (McKelvery et al. 2000). Although the U.S. Fish and Wildlife Service Web site indicates that there are “at least 247 bounty records of lynx from 12 counties in the state,” Oregon Department of Fish and Wildlife indicated that the lynx is very rare and is known from only 17 verified specimens recorded between 1897 and 1993 and that Oregon Department of Fish and Wildlife records, maintained since 1922, show that four of these individuals were taken during trapping. Only three specimens are recorded for southeastern Washington; one from the Blue Mountains (1931) and two from arid grasslands in 1962 and 1963 (McKelvery et al. 2000). These most current specimens in the Blue Mountains were found in anomalous habitats within several years of peak lynx populations in western Canada (*ibid*)

In August 2013, the Forest Service and the U.S. Fish and Wildlife Service revised the Canada Lynx Conservation Assessment and Strategy that was initially established in 2000. The Blue Mountains national forests are listed as unoccupied based on the completion to protocol of the National Lynx Survey. The Conservation Agreement further states that the Forest Service agrees that forest plans in states where lynx are listed should include guidance to conserve lynx for those portions of administrative units identified as occupied lynx habitat. Direction included in an August 2006 memorandum (USFWS 2006) indicated that “…the lynx should not appear on species lists for proposed Federal actions on national forests determined to be unoccupied by

[10] For example Forest Service Handbook 2670.21 Threatened and Endangered Species 1. Manage National Forest System habitats and activities for threatened and endangered species to achieve recovery objectives so that special protection measures provided by the Endangered Species Act are no longer necessary. Or FSH 2670.22 Sensitive Species 1. Develop and implement management practices to ensure that species do not become threatened or endangered because of Forest Service actions.

lynx. Compliance with section 7 (a)(2) of the Endangered Species Act is not required for the lynx under this circumstance."

Effects from Each Alternative on Canada Lynx

Canada lynx were identified as a surrogate species representing boreal forests (USDA Forest Service 2010), but because of their rarity in the Blue Mountains were not used in that capacity for the plan revision effort. Instead, the boreal owl and the water vole were selected to represent other species, including lynx, in the boreal forest group. According to Witmer et al. (1998), the two issues identified for lynx in the Columbia Basin, were (1) conservation of appropriate mosaics of seral stages in boreal forest habitat, and (2) harvest and human disturbance.

Lynx require early seral stage boreal forest habitats for foraging and relatively small patches of late-successional forest to provide for denning opportunities. Analysis for the two surrogate species for the cold forest (see Table 329) resulted in decreasing the level of concern (boreal owl) or maintaining a low level of concern (water vole) regarding their viability (see Table 333 through Table 335). This would indicate that at the broad scale, habitat for the lynx is being maintained or moved towards historical range of variability. This is also supported by the vegetation analysis (see the "Forest Vegetation," "Timber and Forest Products," and "Wildland Fire" sections) which indicates that the early seral stage is close to the low range of historical range of variability and that the late successional stage of cold forest is above historical range of variability for multi-storied stands. This coupled with the fact that there is little active timber harvest anticipated in the cold forest for any alternative should result in the maintenance of lynx habitat throughout the life of the plan. The Blue Mountains are considered unoccupied by resident lynx (USDA Forest Service 2006) and a change in suitable habitat on the fringe of lynx range would not be expected to have any impact on the lynx population, therefore implementing any of the alternatives would have no impact to the Canada lynx.

Gray Wolf

Second only to humans in adapting to climate extremes, gray wolves once ranged from coast to coast and from Alaska to Mexico in North America. Records indicate all wolves were eliminated from the Blue Mountains in the early 1900s after Euro-American settlement. In January 1995, wolves from Canada were transplanted to the Salmon River drainage in central Idaho. In the winter of 1998-99, a collared wolf from this population (B-45-F) moved into northeast Oregon, eventually being captured by the United States Fish and Wildlife Service in March 1999 near the Middle Fork of the John Day River and returned to Idaho (ODFW 2005 (updated 2010)). Another collared wolf, from the White Cloud pack in Idaho, was killed on the freeway just south of Baker City, Oregon in May 2000 (*ibid*). Wolves have successfully colonized portions of Idaho and more recently have become established in northeast Oregon, confirming that suitable wolf habitat exists in the Blue Mountains.

On May 5, 2011, the U.S. Fish and Wildlife Service published a final rule (as directed by Congressional legislative language in the enacted Fiscal Year 2011 appropriations bill) reinstating the Service's 2009 decision to delist biologically recovered gray wolf populations in the Northern Rocky Mountains, including a portion of Oregon and Washington. Wolves in Oregon located west of Highways 395-78-95 and in Washington east of Highway 97-17-395 remain protected by the Endangered Species Act. The U.S. Fish and Wildlife Service is the lead management agency for wolves that occur west of Highways 395-78-95 (OR) and Highways 97-17-295 (WA) and all provisions of the Endangered Species Act apply.

Currently gray wolves are considered endangered west of highway 395 in the Blue Mountains and east of 395 they are included on the Regional Forester's Sensitive Species List (see Figure 42) and managed under the wolf management plan for Oregon (ODFW 2005, updated 2010). For the Malheur National Forest, the wolf would be considered federally listed on 43 percent of National Forest System lands. For the Umatilla National Forest, the wolf would be considered federally listed on only 20 percent of National Forest System lands. The wolf would be included on the Regional Forester's Sensitive Species List throughout the Wallowa-Whitman National Forest. The Oregon Department of Fish and Wildlife is currently monitoring eleven wolf packs. Currently there are no known packs within the Malheur National Forest. On the Umatilla there is one unnamed estimated use area that includes area to the west of State Highway 395, the area where wolves are listed as Federally Endangered. The remaining wolf packs are currently using areas east of State Highway 395, where they have been delisted.

Based on the Northern Rocky Mountains Wolf Recovery Plan (USFWS 1987), three key wolf habitat components are necessary: (1) year-round prey base of ungulates and alternative prey, (2) secluded denning and rendezvous sites, and (3) open spaces with minimal exposure to humans. Wisdom et al. (2000) suggested four major challenges to wolf conservation within the Interior Columbia Basin: excessive mortality from humans, mortality related to roads, displacement from habitat by human activities, and population isolation. The Oregon wolf management plan recognized that "human tolerance has been and remains the primary limiting factor for wolf survival."

Effects from Each Alternative on Gray Wolf

The gray wolf was included in the habitat generalist group, which was represented by the wolverine as a surrogate species. Like other species in this group, wolves are sensitive to risk factors that can cause disturbance.

Because wolves are habitat generalists that hunt and den in a wide variety of vegetation types, the alternatives would have little effect on the amount and distribution of habitat used by wolves or their prey species (USFWS 2003). Gray wolf populations are primarily limited by nonhabitat factors, such as direct interaction with humans that cause mortality (Bangs et al. 1998) and to a lesser degree denning disturbance (ODFW 2005 [updated 2010]). In some areas, wolves are capable of occupying habitats with few conflicts that might be considered marginal based on human population densities and land management practices. However, most of the known wolf mortality that has occurred within the population has been in response to livestock depredations. Wolves that have a history of livestock depredations are lethally controlled by agents of USDA-APHIS Wildlife Services. Most of the depredation problems in Oregon have been within the Wallowa-Whitman National Forest.

Wolves are most vulnerable to disturbance while denning and rearing pups. Wolf interaction with humans is perhaps most influenced by human accessibility to remote habitats. Several researchers have documented the effects of roads, and other human activities on wolves (Thiel 1985, Mech 1989, Carroll 2003, Carroll et al. 2006, Larsen and Ripple 2006). Two measures have been used to assess impacts to wolves; motorized disturbance and acres suitable for cattle and sheep grazing.

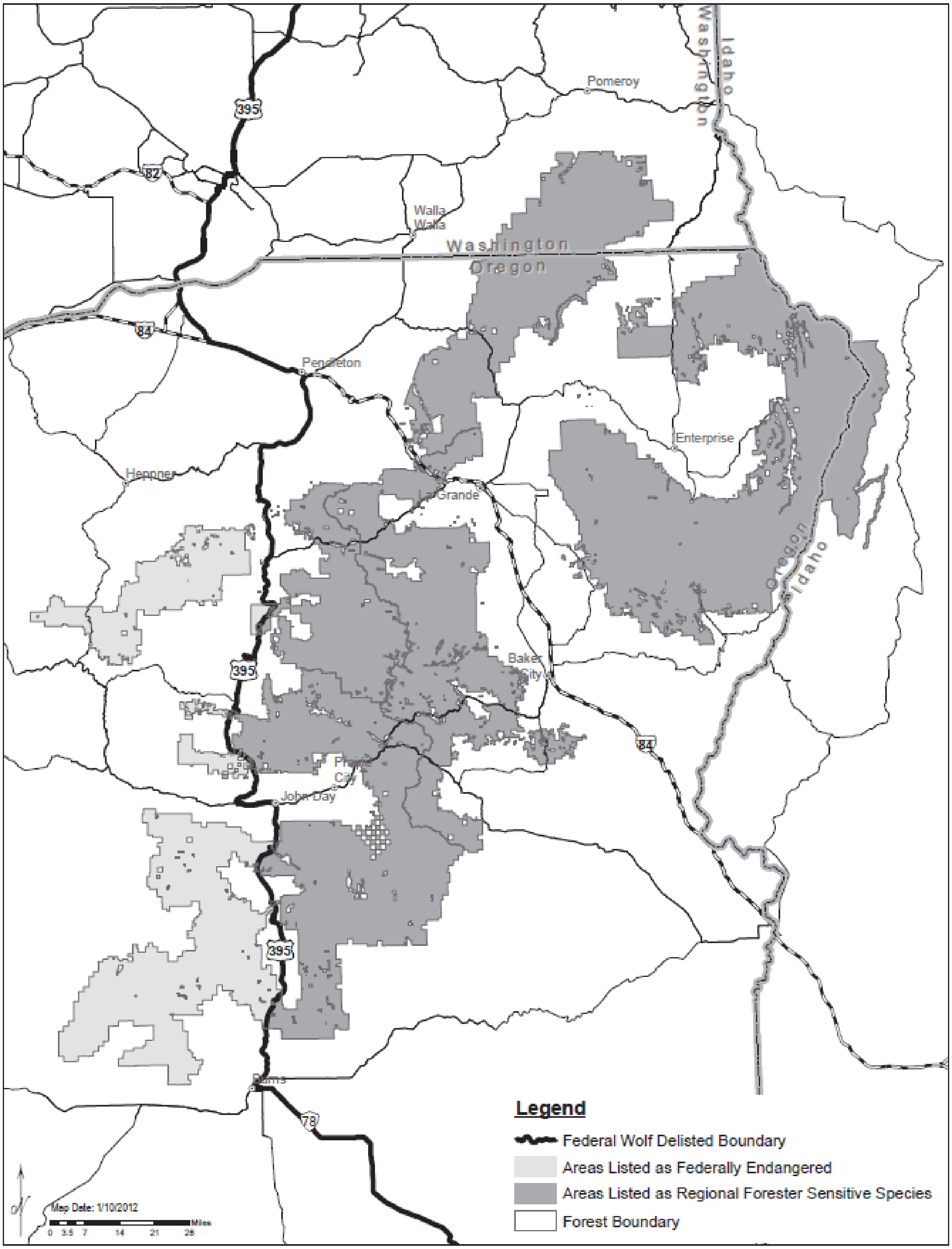

Figure 42. Status of the gray wolf in reference to the national forests within the Blue Mountains

Alternative A – No Action

Implementation of this alternative would have limited opportunity to reduce the negative effects of roads on wolves. The current management direction for roads is limited standards for road densities that vary by management area on the Malheur and the Wallowa-Whitman and off-route motor vehicle travel is generally allowed. On the Umatilla, open road density is a desired condition and off-route motor vehicle travel is limited to designated routes.

This alternative would not change the current level of summer motorized trail use, thus would not change the impacts to habitat effectiveness for wolves. Road-associated risk factors such as displacement from key habitats, risk of mortality from collisions with vehicles, and disturbance during critical time periods would continue.

Overall, this alternative would provide a level of habitat effectiveness for wolves that is similar to Alternatives B, D, E, and F but less than Alternative C, E-Modified, and E-Modified Departure.

There would be no change in area considered suitable for livestock grazing and thus no change in the potential for wolf conflict with domestic livestock.

Alternative B

Open motor vehicle route density would change from a standard and/or guideline in alternative A to a desired condition depending on the management area. General Forest (MA 4A) management would have a desired condition of an open route density of 2.4 miles per square mile. The desired condition for open motor vehicle route density in motorized backcountry management areas would have a desired condition of 1.5 miles per square mile. Winter elk habitat would have a desired condition of 1.5 miles per square mile.

As compared to the no action, the percent change in area suitable for summer motor vehicle use would increase by about 7 percent on the Malheur and Umatilla National Forests, and change little on the Wallowa-Whitman.

Alternative B includes a guideline that would prohibit new system road and trail construction within existing old forest or high elevation riparian areas. This management direction would reduce road-associated risk factors such as displacement from key habitats, risk of mortality from collisions with vehicles, and disturbance during critical time periods.

This alternative is very similar to Alternative A in terms of the amount of area suitable for livestock use and would not represent an appreciable change in the potential for conflict with livestock as compared to the current condition.

Alternative C

The implementation of Alternative C would reduce the effects of motorized access on wolves through the designated amount of area in different management areas. Desired Conditions for MA3C (Wildlife Corridor) would result in road density of 1.0 mile per square mile on about 6.5 percent of the Umatilla National Forest, about 11 percent of the Malheur National Forest, and about 10 percent of the Wallowa-Whitman National Forest. Alternative C would reduce the area designated as suitable for summer motor vehicle use by 45 percent on the Umatilla, 38 percent on the Malheur, and 53 percent on the Wallowa-Whitman national forest compared to the current condition. In addition, Alternative C includes a standard that would prohibit new road and trail construction within existing old forest or high elevation riparian areas. This management direction would reduce road-associated risk factors to the gray wolf such as displacement from

key habitats, risk of mortality from collisions with vehicles, and disturbance during critical time periods.

Alternative C would also reduce the potential for conflict with domestic livestock the most. It proposes the least amount of area considered suitable for domestic livestock grazing.

Alternative D

This alternative responds to requests for more public motor vehicle access. This alternative results in more areas suitable for summer motor vehicle use compared to the other alternatives as management allocations emphasize areas where active management may occur. In this alternative, the desired conditions for open motor vehicle route density in General Forest (MA-4A) is 3 miles per square mile or less.

As compared to the no action, the percent change in area suitable for summer motor vehicle use would increase by about 10 percent on the Malheur and Umatilla, and about one percent on the Wallowa-Whitman.

Similar to other plan revision alternatives, Alternative D includes a guideline that would prohibit new road and trail construction within existing old forest or high elevation riparian areas. This management direction would not increase road-associated risk factors such as displacement from key habitats, risk of mortality from collisions with vehicles, and disturbance during critical time periods for gray wolves. However, risk to motorized travel is highest in this alternative as compared to all other alternatives.

This alternative is very similar to Alternative A in terms of the amount of area suitable for livestock use and would not represent an appreciable change in the potential for conflict with livestock as compared to the current condition.

Alternatives E and F

The main difference between Alternatives E and F is the amount of vegetation treatment. There is no difference in the direction for motorized access between these alternatives. However, the amount of human disturbance during vegetation treatments will be greater in Alternative E, as acres treated per year is higher.

These alternatives contain no desired conditions for open-road densities in General Forest (MA-4A), although there are designated small amounts of wildlife corridor (MA 3C) linking high quality, unroaded wildlife habitats which have a desired condition of open motor vehicle route density of less than 1.0 mile per square mile. However, the area in this management area is less than 22,000 acres on only the Umatilla and the Wallowa-Whitman combined.

As compared to the Alternative A, the percent change in area suitable for summer motor vehicle use would increase by about 8 percent on the Malheur and decrease by less than 10 percent on both the Umatilla and Wallowa-Whitman.

Similar to other plan revision alternatives, Alternatives E and F include guidelines that would prohibit new road and trail construction within existing old forest or high elevation riparian areas. This management direction would not increase road-associated risk factors such as displacement from key habitats, risk of mortality from collisions with vehicles, and disturbance during critical time periods for gray wolves.

Risk from motorized travel in both these alternatives is similar to Alternatives A and B. Risks remains high as little change is expected in motorized travel as compared to the existing condition.

The widespread influence of existing roads across the Plan Area would continue to limit the viability outcome for wolves. However, the greatest threat to the viability of gray wolves, though impacted by motorized access, is most likely due to mortality caused by interaction with humans (ODFW 2015).

This alternative is very similar to Alternative A in terms of the amount of area suitable for livestock use and would not represent an appreciable change in the potential for conflict with livestock as compared to the current condition.

Alternatives E Modified and E-Modified Departure

The main difference between these alternatives is the amount of vegetation treatment. There is no difference in the direction for motorized access between these alternatives. However, the amount of human disturbance during vegetation treatments will be greater in Alternative E-Modified Departure, as acres treated per year is higher.

Under these alternatives, management direction for roads would include no net increase in road miles in key watersheds and a standard to increase elk security within elk priority areas. The amount of area designated as suitable for summer motorized use would decrease minimally on the Umatilla, increase by 5 percent on the Malheur, and decrease by 4 percent on the Wallowa-Whitman. It is anticipated that the creation of additional elk security under these alternatives would encourage elk to remain on public land where they would be accessible to wolves as opposed to spending time on private land where tolerance for wolves is low.

Summary

All plan revision alternatives have standards and guidelines designed to minimize conflict between wolves and livestock as well as minimize disturbance to denning wolves. In addition, all plan revision alternatives include guidelines that would prohibit new road and trail construction within existing old forest or high elevation riparian areas. This management direction would not increase road-associated risk factors such as displacement from key habitats, risk of mortality from collisions with vehicles, and disturbance during critical time periods for gray wolves.

Alternatives C, E-Modified, and E-Modified Departure would be most beneficial to wolves in terms of reducing effects from motorized disturbance. Alternative C would reduce the area designated as suitable for summer motor vehicle use by 45 percent on the Umatilla, 38 percent on the Malheur, and 53 percent on the Wallowa-Whitman National Forest compared to the current condition. Alternatives E-Modified and E-Modified Departure would have little change in the amount of area suitable for summer vehicle use as compared to the current condition but they are expected to improve elk distribution by reducing motorized disturbance within elk priority areas, which could be beneficial to wolves. Alternative C may have the greatest positive impact to wolves because in addition to reducing motorized disturbance, this alternative would also greatly reduce the number of acres suitable for domestic livestock use, potentially reducing the risk of interaction with livestock that could lead to lethal removal of wolves. However, there is no anticipated reduction in the prey population for the wolf so implementing the plan may affect individuals but would continue to provide for the viability and persistence of the wolf during the plan period.

Wolverine (Proposed Species)

The North American wolverine became a Federal proposed species February 4, 2013. The wolverine was evaluated as a surrogate species for the habitat generalist group, which included the gray wolf and the peregrine falcon. It is sensitive to risk factors that can cause disturbance (Copeland et al. 2007, Gaines et al. 2003, Krebs et al. 2007) as are the other species in this group.

Wolverines are considered habitat generalists, and their home ranges are so large that they are usually measured in hundreds of square miles rather than thousands of acres. Recent radio telemetry studies of wolverines in the Rocky Mountains of British Columbia (Krebs et al. 2007) and the United States (Copeland 1996, Copeland et al. 2007, Squires et al. 2007) indicate that wolverines are wide-ranging, inhabit remote areas near timberline, and are sensitive to human disturbance at natal and maternal den sites. Interestingly, Aubry et al. (2007), in their historical review of wolverine distribution in the west, concluded that wolverines detected in Oregon in recent decades “probably represent extreme dispersal events that were not representative of self-sustaining populations” because “there is no evidence of wolverine occurrence in eastern Washington or Oregon currently.” Edelmann and Copeland (1999) indicated that of the 150 sightings for Oregon, at least some of them occurred in the Wallowa Mountains. Using remote cameras and bait stations Magoun et al. (2011) recently documented at least three individuals in the Eagle Cap Wilderness Area of the Wallowa-Whitman National Forest. It is still uncertain, however, if breeding takes place in the Blue Mountains Plan Area.

Suitable wolverine habitat in Oregon occurs in the high-elevation forests of the Cascade Range, the Blue Mountains, the Wallowa Mountains, and the Ochoco Mountains. Habitat areas for wolverines are usually isolated and described as patchy, often separated by large areas of unsuitable habitat. The assessment model (Wales et al. 2011) identified source habitat as the cool moist and cold dry (including white-bark pine) potential vegetation groups above 4,000 feet in elevation. Alpine cirques with boulder fell fields offer the primary denning habitat for wolverines in Idaho, and may also do so in Oregon (Magoun and Copeland 1998). Montane coniferous forests, suitable for winter foraging and summer kit rearing, may only be useful if connected with subalpine cirque habitats required for natal denning, security areas, and summer foraging (Copeland 1996).

Similar to other large mammalian carnivores in the Rocky Mountains (e.g., *Ursus arctos, Canis lupus*), the current distribution of wolverines may be determined more by intensity of human settlement than by biophysical factors such as vegetation type or topography (Banci 1994, Carroll et al. 2001, Kelsall 1981). Thus, specific habitat needs are not as important as reducing human disturbance, particularly in natal den sites (subalpine talus cirques) during the denning period.

Effects from Each Alternative on Wolverine

Motorized recreation and the use of forest roads may influence the habitat use and populations wolverines. These potential effects include displacement from key habitats, disturbance during critical periods, and the risk of mortality caused (see Wisdom et al. 2000 and Gaines et al. 2003 for a complete list of road and trail associated factors that influence wolverine). The effects of motorized recreation and roads can occur during the non-winter period or during the winter period when snowmobiling or ski-trail grooming occurs.

Forest activities that influence the recovery of wolverines includes management of human access that can displace these species from important seasonal habitats or increase the risk of wolverine-human interactions. Several researchers have documented the effects of roads, and other human activities on wolverines (Carroll et al. 2001, Copeland et al. 2007, Krebs et al. 2007, Raphael et

al. 2001, Rowland et al. 2003, Wisdom et al. 2000). For this reason, the discussion of effects to wolverine will focus on motorized disturbance.

Alternative A –No Action

Implementation of this alternative would have limited opportunity to reduce the negative effects of roads on wolverine habitat. The current management direction for roads is limited standards for road densities that vary by management area on the Malheur and the Wallowa-Whitman and off-route motor vehicle travel is generally allowed. On the Umatilla, open road density is a desired condition and off-route motor vehicle travel is limited to designated routes.

This alternative would not change the current level of winter or summer motorized trail use, thus would not change the impacts to habitat effectiveness for wolverines. Road-associated risk factors such as displacement from key habitats, risk of mortality from collisions with vehicles, and disturbance during critical time periods would continue at the current level.

Overall, this alternative would provide a level of habitat effectiveness for wolverines that is similar to B, D, E, and F but less than Alternatives C, E Modified, and E-Modified Departure.

Alternative B

Open motor vehicle route density would change from a standard and/or guideline in Alternative A to a desired condition depending on the management area. General Forest (MA 4A) management would have a desired condition of an open route density of 2.4 miles per square mile. The desired condition for open motor vehicle route density in motorized backcountry management areas would have a desired condition of 1.5 miles per square mile. Winter elk habitat would have a desired condition of 1.5 miles per square mile.

As compared to the no action, the percent change in area suitable for summer motor vehicle use would increase by about 7 percent on the Malheur and Umatilla National Forests, and change little on the Wallowa-Whitman. The percent change in area suitable for winter over-the-snow vehicle use decreases by less than 5 percent on all National Forests. Winter recreation is a risk factor for wolverine (Wales et al. 2011).

Alternative B includes a guideline that would prohibit new road and trail construction within existing old forest or high elevation riparian areas. This management direction would not increase road-associated risk factors such as displacement from key habitats, risk of mortality from collisions with vehicles, and disturbance during critical time periods.

The implementation of this alternative would make a relatively low contribution to the recovery of wolverine populations and habitat restoration. This alternative does not alter the current effects that summer and winter motorized trails have on habitat effectiveness for wolverine.

Alternative C

The implementation of Alternative C would reduce the effects of motorized access on wolverine through the designated amount of area in different management areas. Desired Conditions for MA3C (Wildlife Corridor) would result in road density of 1.0 mile per square mile on about 6.5 percent of the Umatilla National Forest, about 11 percent of the Malheur National Forest, and about 10 percent of the Wallowa-Whitman National Forest. Alternative C would reduce the area designated as suitable for summer motor vehicle use by 45 percent on the Umatilla, 38 percent on the Malheur, and 53 percent on the Wallowa-Whitman national forest compared to the current condition. In addition, Alternative C includes a standard that would prohibit new road and trail

construction within existing old forest or high elevation riparian areas. This management direction would not increase road-associated risk factors to the wolverine such as displacement from key habitats, risk of mortality from collisions with vehicles, and disturbance during critical time periods.

This alternative would also address the risk factor of winter motorized access which has the potential to cause displacement from key habitats or disturbance during critical time periods (e.g., denning). This alternative would reduce the amount of area suitable for winter motorized access by 30 percent on the Umatilla, 28 percent on the Malheur, and 38 percent on the Wallowa-Whitman national forests compared to the current condition.

The implementation of Alternative C would likely make limited improvements to the viability outcomes for the wolverine influenced by risk factors associated with both summer and winter motorized access.

Alternative D

This alternative responds to requests for more public motor vehicle access. This alternative results in more areas suitable for summer and winter motor vehicle use compared to the other alternatives as management allocations emphasize areas where active management may occur. In this alternative, the desired conditions for open motor vehicle route density in General Forest (MA-4A) is 3 miles per square mile or less.

As compared to the no action, the percent change in area suitable for summer motor vehicle us would increase by about 10 percent on the Malheur and Umatilla, and change little on the Wallowa-Whitman. The percent change in area suitable for winter motor vehicle use changes little. Winter recreation is a risk factor for wolverine (Wales et al. 2011).

Alternative D includes a guideline that would prohibit new road and trail construction within existing old forest or high elevation riparian areas. This management direction would not increase road-associated risk factors such as displacement from key habitats, risk of mortality from collisions with vehicles, and disturbance during critical time periods for wolverine.

The implementation of this alternative would make a relatively low contribution to the recovery of wolverine populations and habitat restoration. This alternative includes limited management direction to reduce the effects of roads on habitat effectiveness for these species. This alternative does not alter the current effects that summer and winter motorized trails have on habitat effectiveness for this species. Risk associated with motorized travel is highest in this alternative as compared to all other alternatives.

Alternatives E and F

The main difference between Alternatives E and F is the amount of vegetation treatment. There is no difference in the direction for motorized access between these alternatives. However, the amount of human disturbance during vegetation treatments will be greater in Alternative E, as acres treated per year is higher. These alternatives include limited management direction to reduce the effects of motorized access on these species and their habitats. These alternatives contain no desired conditions for open-road densities in General Forest (MA-4A), although there are designated small amounts of wildlife corridor (MA 3C) linking high quality, unroaded wildlife habitats which have a desired condition of open motor vehicle route density of less than 1.0 mile per square mile. However, the area in this management area is less than 22,000 acres on only the Umatilla and the Wallowa-Whitman combined.

As compared to the Alternative A, the percent change in area suitable for summer motor vehicle use would increase by about 8 percent on the Malheur and decrease by less than 10 percent on both the Umatilla and Wallowa-Whitman. For both these alternatives, the percent change in area suitable for winter over-the-snow vehicle use change little on the Malheur and decrease by less than 10 percent on both the Umatilla and Wallowa-Whitman.

Alternatives E and F do include guidelines that would prohibit new road and trail construction within existing old forest or high elevation riparian areas. This management direction may reduce road-associated risk factors such as displacement from key habitats, risk of mortality from collisions with vehicles, and disturbance during critical time periods for wolverine.

These alternatives do not alter the current effects that summer and winter motorized trails have on habitat effectiveness for this species. Risk from motorized travel in both these alternatives is similar to Alternatives A and B. Risks remains high as little change is expected in motorized travel as compared to the existing condition.

The widespread influence of existing roads across the Plan Area would continue to limit the viability outcomes for wolverine. As a result, the risk factors associated with motorized access would likely continue to reduce the viability of wolverine (see wolverine, table 333 through table 335).

Alternatives E Modified and E-Modified Departure

Under these alternatives, management direction for roads would include no net increase in road miles in key watersheds and a standard requiring that road maintenance and new road construction shall be designed to minimize adverse effects to threatened, endangered, proposed, or candidate aquatic species. In addition, there is a standard to increase elk security in elk priority areas under these alternatives. The amount of area designated as suitable for summer motorized use would decrease minimally on the Umatilla, increase by 5 percent on the Malheur, and decrease by 4 percent on the Wallowa-Whitman. The area suitable for winter-motorized access would be reduced by 7 percent on the Umatilla, 2 percent on the Malheur, and 5 percent on the Wallowa-Whitman.

Summary

In montane habitats in the southern latitudes, wolverines remain at high elevation throughout the year, avoiding lower elevation habitats with xeric conditions (Copeland et al. 2010). Several authors have attributed this to human influence (Carroll et al. 2001, May et al. 2006, Rowland et al. 2003). Carroll et al. (2001) found areas with road densities less than 1 mile per square mile to be strongly correlated with the presence of wolverine. Rowland et al. (2003), in a test of the Raphael et al. (2001) model, found that road density was a better predictor of wolverine abundance than amount of habitat when applied at the watershed scale.

Alternative D would provide the least benefit to wolverine compared to other alternatives. Risk associated with motorized travel is highest in this alternative as compared to all other alternatives. This alternative results in more areas suitable for summer and winter motor vehicle use compared to the other alternatives and it has the highest desired condition for road density within MA 4A.

Alternative C would provide the greatest reduction in the risk of encounters between wolverines and humans, because it has the most area in backcountry management areas. Additionally, Alternative C establishes MA 3C which is intended to be managed for linkages between large blocks of backcountry. This alternative would also significantly reduce the risk factor of winter

motorized access which has the potential to cause displacement from key habitats or disturbance during critical time periods (like denning). This alternative would reduce the amount of area suitable for winter motorized access by 30 percent on the Umatilla, 28 percent on the Malheur, and 38 percent on the Wallowa-Whitman national forests compared to the current condition.

Alternatives E-Modified and E-Modified Departure would not be as beneficial as Alternative C, but would provide some mitigation of road-related risk factors. While the amount of area suitable for motorized use would be similar to the existing condition, standards under these alternatives would mitigate the creation and impacts from new roads. These standards would benefit wolverine in areas where their range overlaps with key watersheds, elk priority areas, and federally listed aquatic species.

The sensitivity of wolverine to the effects of climate change are considered high (McKelvey et al. 2011, Gaines et al. 2012). Because the extent of persistent spring snow cover has constrained current and historical distributions, then it is reasonable to assume that it will also constrain the wolverine's future distribution (Copeland et al. 2010 and Aubry et al. 2007).

An important climate change adaptation that has been recommended is to reduce the negative effects of non-climate related stressors such as the effects of roads (and trails) on habitat (Gaines et al. 2012, Lawler et al. 2014). By reducing the negative effects of roads, habitats can become more resilient to the effects of climate change, and habitat connectivity can be restored allowing wolverines to adjust their ranges as conditions change.

All plan revision alternatives incorporate a standard that prohibits management activities near denning sites of wolverines and other threatened, endangered, proposed or sensitive species. Although there is a high to moderate level of concern for viability under all alternatives and individuals may be impacted, overall management direction of any of the alternatives would contribute to habitat conditions for viability and persistence of this species.

Forest Service Sensitive Terrestrial Wildlife Species

Sensitive species are defined as those plant and animal species identified by the regional forester for which population viability is a concern, as evidenced by significant current or predicted downward trends in population numbers or density and habitat capability that would reduce a species' existing distribution (Forest Service Manual 2670.5). Management of sensitive species "must not result in a loss of species viability or create significant trends toward Federal listing" (Forest Service Manual 2670.32). The regional forester is responsible for identifying sensitive species and shall coordinate with Federal and state agencies and other sources, as appropriate, in order to focus conservation management strategies and to avert the need for Federal or state listing as a result of national forest management activities.

Many of the terrestrial wildlife species from the Pacific Northwest Region Sensitive Species List (2011) were included in the 209 species of concern identified by Wales et al. (2011). Surrogate species were then selected that best represented the habitats and risk factors associated to a group of wildlife species, including Pacific Northwest Region Sensitive Species (table 336). Thus by addressing habitats and risk factors for surrogate species, these factors are also addressed for sensitive species, and a wide range of other wildlife species. The effects analysis for surrogate species was based on the viability assessment process (see USDA Forest Service 2006, Suring et al. 2011, Gaines et al. 2017) so that each alternative was evaluated for its ability to contribute to the viability of surrogate species. Additional and more detailed effects analyses for Pacific Northwest Region sensitive species are required for project level planning.

Table 336. Special status species for the Blue Mountains (from the 2011 Regional Forester's Sensitive Species List), their associated surrogate species, habitat groups and risk factors

Habitat Group	Risk Factors	Surrogate Species	Pacific Northwest Region Sensitive Birds and Mammals	Pacific Northwest Region Sensitive Invertebrates
Boreal Forest	Loss of large trees and snags, Road density	Boreal Owl	Wallowa Rosy-Finch, Black Rosy Finch	Western Bumblebee, Lustrous Copper
Cool-Moist Forest/ Medium-Large Trees	Road density, Created openings, Loss of large trees and snags,	American Marten, Pileated Woodpecker	Not applicable	Humped coin. Shiny Tight Coil
All Forest Communities/ Medium-Large Trees	Grazing, Loss of large trees, Loss of old forest, Human disturbance, Fire exclusion	Cassin's Finch, Northern Goshawk	Great Gray Owl	Fir Pinwheel, Johnson's Hairstreak
Dry Forest/ Medium-Large Trees	Loss of large trees and snags, Fire exclusion	White-headed Woodpecker	White-headed Woodpecker	Meadow Fritillary
All Forest Communities/ Open Forest	Loss of large trees and snags, Fire exclusion	Western Bluebird	Fringed Myotis	Not applicable
Open Forest/ Post-fire	Road density, post-fire timber harvest	Black-backed Woodpecker, Lewis's Woodpecker	Lewis's Woodpecker	Not applicable
Open Forest/ Early Successional	Grazing	Fox Sparrow	Not applicable	Not applicable
Woodland/ Grass/ Shrub	Domestic sheep grazing, fire exclusion, cattle grazing, human disturbance	bighorn sheep, lark sparrow	striped whipsnake, spotted bat, pallid bat, ash-throated flycatcher	Barry's hairstreak, Intermountain sulphur
Grass/Shrub	Grazing, invasive species, human disturbance	northern harrier, sage thrasher	gray flycatcher, green-tailed towhee, greater sage-grouse, pygmy rabbit, sharp-tailed grouse, Preble's shrew, mountain goat, grasshopper sparrow	western bumblebee, Great Basin fritillary, salmon coil
Riparian/Large Tree	Loss of old forest, human disturbance	bald eagle, rocky mountain tailed frog	Rocky Mountain tailed frog, bufflehead, bald eagle, Harlequin duck	Shiny tight coil
Riparian/ Pond/ Small Lake/ Backwater/ Wetland /Open Water/ Wet Meadow	Invasive species, grazing, road density, human disturbance, fire exclusion	marsh wren, Wilson's snipe, Columbia spotted frog	Columbia spotted frog, painted turtle, tri-colored blackbird, bobolink	Meadow fritillary
Riparian/ Shrubby Deciduous	Grazing	MacGillivray's warbler	Mountain quail	Silver-bordered fritillary, Yuma skipper
Open Forest/ Woodland/ Grass/ Shrub/ Cave	Loss of snags, loss of large trees, loss of riparian, loss of roost sites, human disturbance, Insecticides	Fringed myotis, pallid bat, Townsend's big-eared bat	Townsend's big-eared bat, pallid bat, spotted bat	Not applicable
Habitat Generalist/ Cliff	Human disturbance	Peregrine falcon	Peregrine falcon, black swift	Not applicable
Habitat Generalist	Road density, winter recreation	Wolverine	Gray wolf	Not applicable

Effects from Each Alternative on Sensitive Species

The Regional Forester's sensitive species were not analyzed individually, but instead were analyzed either as a surrogate species or were included in a surrogate species group. For example, the bald eagle was found to have a low level of concern for viability on the Malheur and the Umatilla National Forests and a moderate level of concern for viability on the Wallowa-Whitman National Forest (table 331). There was no increase in the level of concern between the existing condition and any of the alternatives indicating that although individual bald eagles may be impacted by implementing the alternatives, none would cause a trend toward Federal listing. Another example would be the tri-colored blackbird which was represented by the marsh wren, or the pygmy rabbit represented by the sage thrasher. Both of the surrogate species had either a low or moderate concern for viability which was not increased in any of the alternatives, indicating that although individuals of a species may be impacted, none of the alternatives would cause a trend toward Federal listing.

It is assumed that species in groups (Table 328) where there is no increase in the level of concern for viability of the representative surrogate species (Table 329, Table 330, and Table 331) would not trend towards federal listing or loss of population viability. Detailed discussions for these species or their representative surrogate species can be found in Wales et al. (2011). Those species identified as "fine scale" species (FS in Table 336) usually have very limited occupied habitat or are locally endemic and are most appropriately addressed at the project level, where the finer scale of analysis allows appropriate identification of their habitats. For example, the shiny tightcoil is only sensitive in Washington, which represents 22 percent of the analysis area, over half of which is in areas not identified for active management. Although associated with ponderosa pine and Douglas-fir vegetation types, it is the talus slopes within these forest types to which they are most closely associated, resulting in a portion of the landscape that cannot be mapped at the forest scale. Such habitats are identified as Special Habitats (1.13) and management would be towards the desired condition, which is that they remain on the landscape and provide high quality habitat for associated species.

Cumulative Effects

Surrogate Species

Boreal owl habitat was estimated by Wisdom et al. (2000) to have decreased by 61 percent within the Columbia River Basin, but only by 3 percent in the Blue Mountains Ecological Reporting Unit compared to historical conditions, resulting in a stable trend for the species in the Blue Mountains. Much of their preferred habitat in the Blue Mountains is within National Forest System lands, and therefore few cumulative effects are anticipated from lands under private, state, or other Federal administration. At the broad scale, Nature Serve ranks the boreal owl as apparently secure (N4) in the United States. The effects of climate change, although uncertain, indicate that a reduction in habitat for this species will probably occur during the next 50 to 100 years within the Blue Mountains.

Cassin's finch is distributed from British Columbia southward and into Mexico during winter. Throughout the conifer belts of North America's western interior mountains, Cassin's finch can be one of the most common and conspicuous breeding birds (Hahn 1996).This finch is considered a year round resident in Oregon and regionally they are commonly found breeding throughout the mountainous west. Wisdom et al. (2000) did not address this species but rather the Hammonds flycatcher, which was placed in the same group as this finch (USDA Forest Service 2010). Wisdom et al. (2000) estimated a 42 percent decrease in source habitat within the Columbia River

Basin, and a 34 percent decrease in the Blue Mountains Ecological Reporting Unit compared to historical conditions for the Hammond's flycatcher. At the broad scale, Nature Serve ranks the Cassin's finch as secure (N5) in the United States and apparently secure (S4) in Oregon. Although the Cassin's finch is associated with open forested stands, which may be more abundant on private lands, they are associated with larger trees, which may not be more abundant on private lands (see "Old Forest" section). No information exists to indicate that management of lands under private, state, or other Federal administration would change; therefore, if the downward trend in habitat within the Blue Mountains as given by Wisdom et al. (2000)is a result of management off-forest, then this continued cumulative effect would be expected.

Western bluebirds breed throughout much of the western United States, Mexico, and southwestern Canada. Apparent declines in numbers of this species in the Pacific Northwest and British Columbia, especially in regions west of the Cascade Range, have generated concern. This was one of the species modeled by Raphael et al. (2001) for the Supplemental Draft Environmental Impact Statement for the Interior Columbia Basin, which resulted in an outcome of C currently for National Forest System and Bureau of Land Management administered lands but changed to a B outcome for two of the alternatives in 100 years and remained the same for one alternative. At the broad scale, Nature Serve ranks the western bluebird as secure (N5) in the United States and apparently secure (S4) in Oregon. Western bluebirds respond positively to artificially constructed nest boxes (Brawn and Balda 1988) and bluebird enthusiasts in Washington, Oregon, and British Columbia have established trails of nest boxes in an effort to reestablish local breeding populations. Cassidy and Grue (2000) estimated that in Washington, more than 57 percent of population occurs on private as opposed to public lands. Continued expansion of residential/industrial areas and changes in agricultural practices could continue to impact suitable areas for breeding and foraging. Some western bluebirds migrate to California and Baja California in winter (DeGraaf et al. 1991) and conditions on these wintering grounds if similar to the above, could affect the status of populations.

Fox sparrows are one of North America's most geographically variable birds with 18 subspecies divided into 3 or 4 distinct groups with equally variable life-history characteristics across its range (Weckstein et al. 2002). Because of its preference for shrubby habitats, fox sparrow probably responds well to the more intensive timber management that occurs on private land, so in this sense the cumulative impacts would be positive. There is no indication that management of lands under private, state, or other Federal administration would change appreciably from current; therefore, few cumulative effects are expected. At the broad scale, Nature Serve ranks the fox sparrow as secure (N5) in the United States and apparently secure (S4) in Oregon. The fox sparrow is migratory, and as such is more likely to be affected by changes in climate, which may result in a phenology mismatch as described by Jones and Cresswell (2009).

Lewis's woodpecker is found throughout ponderosa pine forests in the western United States. The species is migratory within the northern portion of its breeding range with most individuals leaving summer areas during winter. Migratory movements to areas outside of breeding range probably occur annually but vary considerably in magnitude from year to year (Tobalske 1997). Species may winter outside of the breeding range in large numbers one year, but may be almost completely absent from the same areas the next. No data on distances and routes for marked individuals exists. Relatively short-distance migrations (0 to 20 kilometers) occur within the breeding range (Bock 1970, Tashiro-Vierling 1994) and longer-distance migrations (100 to 1,000 kilometers or more) probably occur for individuals breeding in the northern portion of the range. Exact distances are largely unknown due to their irregular movements as breeding and wintering habitat varies and the species is opportunistic in its foraging habits (Bock 1970). Wisdom et al.

(2000) in evaluating the migratory population within the Columbia Basin found that source habitat for this species had the largest negative relative change of any of the species they analyzed. Wisdom et al. (2000) evaluated what is termed secondary source habitat in this analysis, and attributed the decline primarily to a basin-wide change from old-forest ponderosa pine to mid-seral structural stages. They also recognized the loss of cottonwood/willow old forest structure due to a change in the historical hydrological regime. The current direction on federally administered lands would be to manage towards more old-forest within ponderosa pine, but much of the low elevation dry forest is on private lands (ODFW 2006) and is most likely to remain in non-old forest conditions. The vast majority of the cottonwood/willow habitat also occurs on private lands and will probably continue to be managed at an earlier seral structure than preferred by this species. Climate change may actually provide a short term benefit to this species because of the predicted increase in individual tree mortality due to stress (van Mantgem et al. 2009) as well as a warmer climate that has already lead to more frequent and severe fires in the western United States (Westerling et al. 2006), increasing the primary habitat for this species. Association with agricultural settings likely exposes Lewis's woodpecker to herbicides and insecticides (Abele et al. 2004, Tashiro-Vierling 1994), which could have potential negative effects.

Because habitats on a whole are projected to increase in the Blue Mountains for all alternatives, public lands should contribute to viability within the region. The effects of climate change, although uncertain, indicate that a change in habitat for terrestrial species will occur during the next 50 to 100 years within the Blue Mountains. If the anticipated increase in fire severity and frequency due to drier conditions occurs, this could lead to an improvement, at least in the short term, in habitat for the western bluebird and fox sparrow, while reducing habitat for the boreal owl.

Bighorn sheep are native to western North America, from British Columbia to Mexico. Within this range, several subspecies occur. Populations have been greatly reduced throughout its range from a once very common abundance. It has been estimated that half the bighorn sheep habitat within the Columbia River Basin, is currently unoccupied (Wisdom et al. 2000). Disease transmission between domestic sheep and wild sheep is considered the greatest threat to wild sheep populations. There are private lands where domestic sheep currently graze immediately adjacent to public lands. Additionally, domestic sheep are a common 4-H project, which may also place them within foray distances of existing and/or future wild sheep range increasing the risk of disease spreading to wild sheep populations. These represent potential risks to wild sheep that the Forest Service has no influence over.

Threatened, Endangered, Proposed, and Candidate Species

The gray wolf has circumpolar distribution in the northern latitudes. It occurs in Europe, Asia and North America. In North America, it is considered common in Alaska and most of Canada. Within the recovery areas of the U.S., populations have been increasing, with the largest populations in Minnesota, Michigan, and Wisconsin. Eastern Oregon has recently been colonized by wolves thought to have originated in Idaho. Gray wolf populations are increasing in eastern Oregon and this trend is likely to continue during the short term due to high prey populations, decreasing open motor vehicle route density across the Blue Mountains and management direction to protect denning wolves. As populations increase wolves will continue to disperse into new areas, eventually increasing contact with human populations and activities. Habitat does not appear to be limiting, and therefore the greatest threat is mortality due to interaction with humans. The legal and illegal killing of individuals, both on and off public lands is of concern. Hunting in Idaho could potentially pressure more individuals to relocate to Oregon. Increased livestock depredation

and interaction with humans could lead to lethal removal of individuals by the state game department as well as the illegal shooting of individuals, which has already occurred. Over the long term, human social pressures will likely restrict the distribution of wolves to areas of limited human occupation and away from concentrated domestic livestock production. In the end, the cumulative effect of human tolerance and persecution will have to change to achieve long-term successful recovery.

The wolverine has circumboreal distribution. In North America, it extends across Canada and Alaska, and uses forested and nonforested environments. In the western U.S., wolverine are known to occur in Washington, Idaho, Montana and Wyoming. Wisdom et al. (2000) estimated a 14 percent increase in source habitat within the Columbia River Basin with more than 80 percent of the watersheds in the Blue Mountains ecological reporting unit (6) showing an increase of more than 100 percent in source habitat compared to historical conditions. Raphael et al. (2001) evaluated wolverine habitat across the Columbia Basin and showed that likely habitat for wolverine occurred more in the northern Blue Mountains than the southern parts (e.g., Malheur National Forest).

Since most wolverine habitat is found on remote, high-elevation National Forest System lands, few cumulative effects are expected from lands under private, state, or other federally administered lands. Probably the greatest threat to wolverines is the ever-increasing disturbance from activities such as snowmobiling, heli-skiing, cross-country skiing, and snowshoeing. Recent advances in snowmobile technology capabilities has raised concerns about their ability to access previously isolated areas (Wisdom et al. 2000) where natal denning may be occurring. Although none of the alternatives attempts to expand this type of recreation in the future, it is anticipated that expansion of such activities will occur.

As with most species that inhabit high elevation habitats of the Blue Mountains, climate change is of concern, but more so with the wolverine. Spring snow cover, which has been shown to strongly correlate with wolverine denning locations and year-round movement, is also correlated to dispersal pathways across the landscape (Copeland et al. 2010, Schwartz et al. 2009). This bioclimatic niche (Copeland et al. 2010) is likely to continue to be strongly impacted by global climate change (Mote et al. 2005), threatening wolverine throughout their geographic distribution as spring snow cover may decrease.

Forest Service Sensitive Species

Many sensitive species of birds, especially those that are migratory, have ranges that encompass landscapes outside of the national forest. As such, they are exposed to threats beyond the control of the Forest Service. For example, the use of insecticides and other agrochemicals associated with cultivation practices has been identified as one of the main threats to the upland sandpipers on their wintering grounds in South America (Vickery et al. 2010). Many of the riparian associated species have been impacted by loss of habitat to agriculture, especially in the lower valley bottoms. Oregon Department of Fish and Wildlife in cooperation with other government agencies has developed programs and strategies to improve riparian habitats on non-federally administered land (ODFW 2006). Some species, such as buffleheads and Harlequin duck are migratory and can be legally hunted throughout the flyway.

Wormworth and Mallon (2006) suggest that projected changes in vegetation shifts caused by climate change could affect bird species. They project that alpine vegetation communities within the arctic would likely be reduced. Although there is a high degree of uncertainty, this same

projected change would likely occur within the Blue Mountains resulting in the loss and fragmentation of habitat.

The vast majority of greater sage-grouse habitat in Oregon does not occur on National Forest System lands, but on lands administered by the Bureau of Land Management (71 percent) and private lands (21 percent). The Baker Population of greater sage-grouse (Wallowa-Whitman National Forest) occurs mostly on private lands where there are limited regulatory mechanisms making it uncertain as to whether state-recommended conservation measures and practices will be applied on the majority of lands supporting this population. It is assumed that Oregon Department of Fish and Wildlife, in cooperation with U.S. Fish and Wildlife Service and Natural Resource Conservation Service, will continue to provide incentives to private landowners for the conservation of sage-grouse habitat. Implementation of the Oregon BLM greater sage-grouse plan will cumulatively benefit sage-grouse habitat. Hunting will continue to be a cumulative impact, but at the current level is not considered a threat to the breeding population (Hagen 2011).

Climate change will have an important influence on sage-grouse habitats, as the various scenarios predict increasing temperature, atmospheric carbon dioxide, and severe weather events all of which favor cheat grass expansion and increased wildfire activity (Miller et al. 2011). Increase temperature predictions suggest that sagebrush habitats could be replaced with other woody vegetation causing further decline in sage-grouse habitats (Bradley 2010, North American Bird Conservation Initiative 2010).

Management Indicator Species – Affected Environment

Species are generally selected as management indicator species in order to estimate the effects of each alternative on fish and wildlife populations. The planning rule states that certain vertebrate and/or invertebrate species present in the area shall be identified and selected as management indicator species and the reasons for their selection will be stated. These species shall be selected because their population changes are believed to indicate the effects of management activities (CFR 219.19(a)(1)). Management indicator species can be chosen from five categories of species:

- Endangered and threatened plant and animal species identified on state and Federal lists
- Species commonly hunted, fished, or trapped
- Nongame species of special interest
- Species with special habitat needs that may be influenced significantly by planned management programs
- Additional plant or animal species selected because their population changes are believed to indicate the impacts of management activities on other species of selected major biological communities or on water quality

The terrestrial management indicator species selected during the last plan revision effort (1990) in the Blue Mountains were selected because their habitat requirements encompassed a broad range of conditions. For the 1990 Forest Plans, the Forest Service identified 24 different species or groups of species as management indicator species. It was anticipated that by selecting and managing for these species the needs of all of the other fish and wildlife species would be adequately met. In the 1990 Forest Plans, there was one general objective for management indicator species: to provide for the habitat requirements of the selected management indicator species and maintain viable populations of management indicator species. However, the 1982 National Forest Management Act regulations do not make a direct link between management

indicator species and viability. Attempts to do so in individual plans have been problematic. Simply stated, population trends of management indicator species are not expected to mirror trends of other species.

The Blue Mountain forest plan revision process used management indicator species for the purpose of assessing the impacts of the alternatives on wildlife and fish populations under procedures of the 1982 Planning Rule (CFR 219.19 (a) (1) and (2)). The no-action alternative (no change in current management) was evaluated in terms of the management indicator species listed in the 1990 Forest Plans. New management indicator species were selected and analyzed for the plan revision alternatives. Detailed rationale for selecting management indicator species for alternatives other than Alternative A is found in the project record. What follows is a description of the management indicator species for the no-action alternative, the management indicator species that are common to all alternatives, and the management indicator species common only to plan revision alternatives. Table 337 is a listing of management indicator species selected for analysis by forest and by alternatives.

Table 337. Management indicator species for each national forest

Management Indicator Species	Management Indicator Species 1990 Plan	Management Indicator Species Revised Plan
Malheur		
American marten	Yes	No
Northern three-toed woodpecker	Yes	No
Primary excavators	Yes	No
Pileated woodpecker	Yes	Yes
Rocky Mountain elk	Yes	No
White-headed woodpecker	No	Yes
Mule deer	No	Yes
Umatilla		
American marten	Yes	No
Northern three-toed woodpecker	Yes	No
Primary excavators	Yes	No
Pileated woodpecker	Yes	Yes
Rocky Mountain elk	Yes	Yes
White-headed woodpecker	No	Yes
Wallowa-Whitman		
American marten	Yes	No
Northern three-toed woodpecker	Yes	No
Primary excavators	Yes	No
Northern goshawk	Yes	No
Pileated woodpecker	Yes	Yes
Rocky Mountain elk	Yes	Yes
White-headed woodpecker	No	Yes

Estimating the population density, let alone population trend, for most any vertebrate species is at best problematic (Bart et al. 2004). Animals often are difficult to capture or observe, they are

harmed in the process, or the associated costs and effort of making absolute counts or censuses are prohibitive (Gibbs 2000). Failure to detect a species' presence in an occupied habitat patch is a common sampling problem when the population size is small, individuals are difficult to sample, or sampling effort is limited (Gu and Swihart 2004). Because accurately estimating absolute population size is difficult, ecologists frequently rely on indices of population size that they monitor over time as a surrogate for monitoring changes in actual population size (Gibbs et al. 1998).

Few long-term data sets exist for the analysis area. Monitoring of wildlife populations and habitats has been lacking or poorly implemented on national forests due largely to the lack of capacity or commitment to fund data collection, management, and analysis (Manley et al. 2006). Population estimates for some of the hunted species, such as elk and mule deer, are available through the state wildlife agencies. Breeding bird surveys and Christmas bird counts represent the only long-term data available to assess broad scale trends in most bird species. Breeding Bird Surveys provide some information regarding status of bird species and the Data is categorized into three credibility ratings. Altman (2000) indicated that 31 routes were at least partially located within the Blue Mountains of Oregon and Washington. Although the breeding bird surveys provides a huge amount of information about regional population change for many species, there are a variety of possible problems with estimates of population change from breeding bird survey data. Limitations of both methods for discerning population trends have been addressed (Sauer et al. 2008). For example, the year-to-year variation in abundance at any one locale may not indicate overall population decline but simply reflect a lack of detection on the part of the surveyor (Sauer et al. 1994) or abandonment on the part of the birds of one location for another.

The Christmas Bird Count data referred to in this document was generated using the number of birds reported per party hour; a measure of the amount of time spent searching for birds or the amount of effort expended. This is one way to standardize Christmas Bird Count data over time. Some years, there may have been many people counting birds, while other years there may have been fewer participants in the field. As Christmas bird count participation fluctuates (and as the number of Christmas bird count circles increases), raw count numbers may also fluctuate (more counters can often lead to more birds reported). This is one method for correcting the differences in effort over time.

A combination of factors, including experience with implementing forest plans during the last decade, court rulings, scientific discourse concerning management indicator species (Andelman and Fagan 2000, Landres et al. 1988, Niemi et al. 1997, Roberge and Angelstam 2004, Wiens et al. 2008), and better understanding of the role of management indicator species have refined how management indicator species are viewed in planning. Management indicator species have always been defined as useful in assessing management effects, but the array of species actually selected often was driven by a desire to have a representative of each habitat that occurred on the national forest and not to assessing management effects (Hayward et al. 2004). Some of the confusion surrounding management indicator species results from the misperception that management indicator species is a special designation, resulting in more protection for the species. The reality is that management indicator species are simply yardsticks to measure the impact to habitats at risk in the alternative phase of planning and then to measure how well the Revised Forest Plan is accomplishing what it said it would accomplish and to verify that the chosen management indicator species are responding in the manner predicted. With the focus on management issues, not every habitat will nor should be represented by a species on the management indicator species list.

The Planning Rule (CFR 219.35(a) and (b)) has directed the Forest Service to use the best available scientific information during forest land management planning. As such the following analysis will try to incorporate new scientific information into the analysis of Management Indicator Species, especially the concept that they are meant to be measures of how well the forest plan is meeting its desired conditions by focusing management direction developed in the alternatives, providing a means to analyze effects on biological diversity, and serving as a reliable feedback mechanism during forest plan implementation (Hayward et al. 2004).

Management indicator species are no longer considered an appropriate approach to addressing species viability. See surrogate species section for discussion on population viability.

Management Indicator Species – Environmental Consequences (Alternative A)

The American marten, primary cavity excavators including the pileated and Northern three-toed woodpecker, and Northern goshawk are all either surrogate species or are included in a family group that is represented by a surrogate species. The American marten, pileated woodpecker, and northern goshawk are surrogate species. The Northern three-toed woodpecker is in the post-fire habitat group, which is represented by the Lewis's woodpecker and black-backed woodpecker surrogate species. Please refer to the "Surrogate Species" section for further discussion.

Management Indicator Species – Environmental Consequences (Plan Revision Alternatives)

Four species were chosen as management indicator species for the revised plan: white-headed woodpecker, pileated woodpecker, Rocky Mountain elk (Wallowa-Whitman and Umatilla) and mule deer (Malheur). All four of these species were also identified as focal species in the monitoring plan. White-headed woodpecker and pileated woodpecker were also selected as surrogate species to represent their habitat group and so effects to population viability for these two species are covered in the surrogate species section.

Rocky Mountain Elk

Elk have been identified as a hunted species that is of interest throughout the Plan Area. Both Oregon (ODFW 2003) and Washington (Fowler 2001) have developed management plans for elk in the Blue Mountains. Elk are important economically, ecologically, socially, and culturally within the Plan Area. Bolon (1994) reported that the value of elk hunting within the Blue Mountains of Oregon and Washington ranges between 17 and 20 million dollars per year.

All three 1990 Forest Plans selected elk as a management indicator species. The Wallowa-Whitman National Forest chose elk because it "is a highly-valued game animal and is selected as a management indicator species because of the quality of habitat diversity, the interspersion of cover and forage areas, and the security of cover provided" (USDA Forest Service 1990b). The Umatilla National Forest selected this species for general forest habitat (USDA Forest Service 1990a) and The Malheur National Forest stated that it was chosen because it was a commonly hunted species (USDA Forest Service 1990).

Rocky Mountain elk were selected as a management indicator species and a focal species for the new planning effort for the Wallowa-Whitman and Umatilla National Forests and will be used to represent security areas/motorized use management. After review of several other forest plan revision efforts (Caribou, Medicine Bow, Payette, Boise, Sawtooth, Uinta, and Wasatch-Cache National Forests) and reviews of the intent of a management indicator species (Cooperrider 2002; Niemi et al. 1997; Owen 2010), it was decided that although hunted species such as elk do not

truly meet the criteria to fulfill the purpose of management indicator species (changes in populations can be directly attributed to Forest Service management), they are very important both socially and economically and, as such, should be carried forward. Because elk occur in every habitat type and at virtually every elevation across the Blue Mountains, they are a useful species to monitor the effectiveness of motor vehicle use management and the change in availability of secure habitat. Open motor vehicle route density is a key element in determining whether elk remain in an area after the hunting seasons have started. If open motor vehicle route density is high, and hiding cover is low, elk will move until secure areas are found. Open motor vehicle route density is often the easiest and most effective attribute to manage since hiding cover criteria may take many years to meet the desired future condition. In addition, fine scale attributes like hiding cover are better managed at the project scale rather than at the landscape level.

The science around elk and elk habitat use has steadily evolved over the past few decades. In the past, management emphasis was placed on sustaining cover and reducing disturbance during hunting seasons to retain elk on National Forest System lands. Research at that time recommended forest managers identify explicit canopy cover amounts and road density goals within important elk habitat, such as winter ranges and select summer ranges. Traditionally, open road density (miles of road open to motorized use per square mile) was the metric used to describe human disturbance impacts on wildlife species such as elk. However, a road density metric alone, although important, does not address complexities in patterns of open routes or the frequency of use by motorized vehicles (Rowland et al. 2000 and Rowland et al. 2005).

Effective security for elk includes non-linear areas that are both greater than one half mile from open motorized routes and at least 250 acres in size (Hillis et al. 1991). This definition of security stems from the “Hillis Paradigm” that was developed in Montana and focused on reducing bull elk vulnerability during hunting season. The metric of one half mile from open motorized routes is validated by research from Starkey Experimental Forest and others that identified this distance as the average minimum distance elk were found away from open motorized routes during hunting seasons (Johnson et al. 2005) and during non-hunting seasons where elk selected for areas between 0.4 and 0.6 miles from an open road (Ager et al. 2003). Elk show increased selection of areas away from open motorized routes up to at least 1.25 miles during summer (Rowland et al. 2000). The use of the open motorized route is the cause of disturbance, not the road itself. Although originally designed to inform management of bull elk during hunting season, if applicable, the Hillis Paradigm may be applied more broadly to encompass other seasons of use by elk. Geographical, topographical, or vegetative characteristics, or a combination of these features also enhance the function of elk security.

Hiding cover is typically capable of hiding 90 percent of standing adult elk from the view of a human at a distance equal to or less than 200 feet during all seasons of the year that elk use for bedding, foraging, wallowing, and other functions. Hiding cover may include, but is not limited to trees, shrubs, rocks, or other landscape features that allow animals to conceal themselves partially or fully (Thomas et al. 1979). Because hiding cover is a fine-scale habitat component that is difficult to quantify at the landscape scale, it is not included in our definition of effective elk security. However, hiding cover can help to mitigate the effects of disturbance.

Elk use of forage areas often depends not only on the quality and quantity of forage but also on the proximity of forage to hiding cover and distance to routes open to motorized vehicles, the seasonal use of the route, and the frequency of use (Wisdom et al. 1986, Coe et al. 2011, Ciuti et al. 2012). Lands that provide elk forage typically display less than 40 percent canopy cover and may include grasslands, meadows, and riparian areas where grasses, sedges, forbs, and shrubs

grow (Thomas et al. 1988, Cook et al. 2016). Lichen, leaves, and bark from trees provide forage during winter.

Recent research conducted at the Starkey Experimental Forest and other sites provides new insights into the importance of maintaining adequate nutritional resources for elk during summer and minimizing human disturbance effects year round through effective management of motorized and nonmotorized uses and vegetative cover (Rowland et al. 2000, Long et al. 2008, Cook et al. 2016, Proffitt et al. 2016). The value of elk forage and hiding cover for a given season and landscape varies based on the biophysical potential of each landscape to sustain forest cover, topography, and nutritional resources. In addition, elk forage and hiding cover adjacent to open and frequently used roads and trails diminishes the value of these areas to elk depending on the distance from routes open to and used by motorized vehicles (Rowland et al. 2005). For example, on landscapes dominated by flat, open terrain and nutritious forage, elk security is often compromised by motorized disturbance and the forage is used less than it would be if there were no open motorized routes. The presence of cattle may also influence elk habitat selection. Studies have demonstrated elk avoidance of cattle during summer (Coe et al. 2001 and Coe et al. 2005).

Rocky Mountain Elk Population Trend – According to CFR 219.19(a)(6), “Populations trends of the management indicator species will be monitored and relationships to habitat determined. This monitoring will be done with State fish and wildlife agencies, to the extent practicable.” All three national forests rely on survey data collected by state fish and wildlife agencies [Oregon Department of Fish and Wildlife (ODFW) and the Washington Department of Fish and Wildlife (WDFW)] for population numbers and trend analysis of all game species. Additionally CFR 219.19(a)(1) states, “These species shall be selected because their population changes are believed to indicate the effects of management activities.”

Although two of the 1990 Forest Plans referred to populations and predicted changes, all three 1990 Forest Plans acknowledged that populations of elk are influenced by many factors, such as predation, hunting, disease, competition with other animals, weather, etc., and that “habitat effectiveness might decline but have no influence on the number of elk”(USDA Forest Service 1990b). Population management through hunting has the greatest influence on population trends. Most elk populations reach a social carrying capacity (the willingness of landowners and local residents to accept elk) well before they reach their environmental carrying capacity (ODFW 2003a). Habitat in general and conifer vegetation types specifically have not proven to be a limiting factor for population expansion in the Blue Mountains.

Figure 43 displays the estimated population and management objectives for game management units that have at least 10 percent of the Malheur National Forest within the boundary. This includes Desolation, Northside, Murderers Creek, Beulah, Malheur River, and Silvies. It would appear that most years the total management objective for the national forest is being met or exceeded. For 2001, data was missing for three of the six geographic management units, but based on estimates for 2000 and 2002 the management objective for 2001 was probably met or exceeded as well. As of 2016 the total population for these units has remained stable at 10,350 elk.

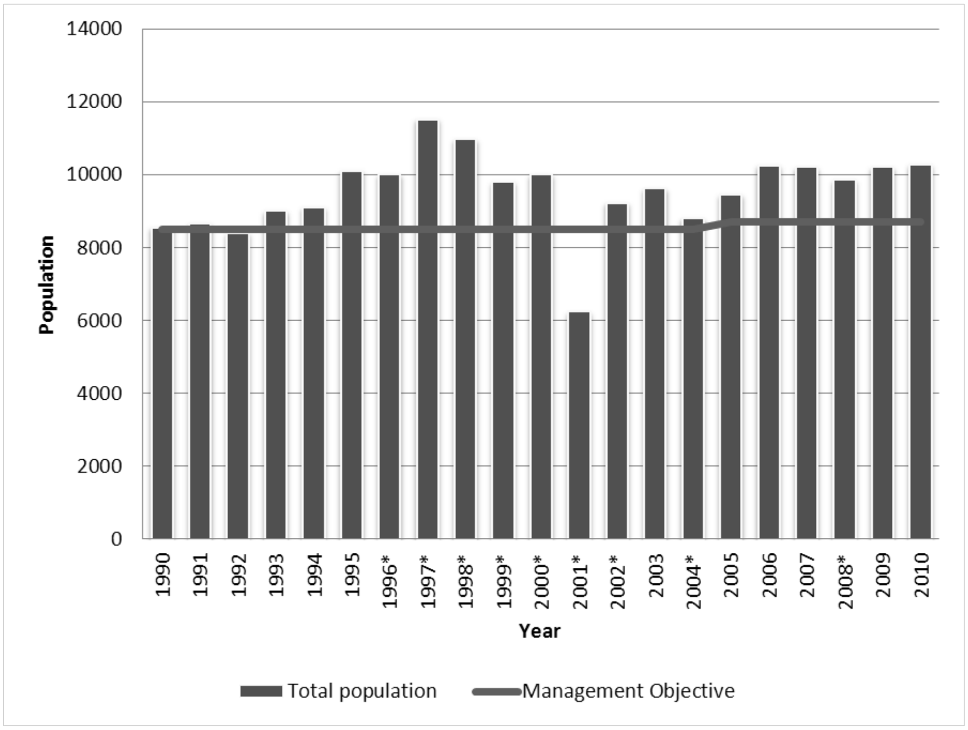

Figure 43. Estimated elk population for game management units within the Malheur National Forest compared to the management objective for 1990-2010 (asterisk indicates data missing for at least one game management unit)

Figure 44 and Figure 45 display the management objective and estimated population for those game management units that contain at least 10 percent of the Umatilla National Forest within unit boundaries. This includes Desolation, Heppner, Ukiah, Wenaha, Mt. Emily, and Walla Walla in Oregon. The Umatilla National Forest also extends into Washington, incorporating all or portions of game management units Dayton, Lick Creek, Mountain View, Tucannon, and Wenaha. The Wenaha and Mountain View herds are interstate herds and the best population data for Wenaha is actually from Oregon (Fowler 2010). Therefore, data for Wenaha was not included in Figure 45.

As displayed in the figures, the management objectives for the two states were not been met during much of the last decade. The Wenaha unit in particular was documented as having low calf survival for multiple years, largely attributed to predation (Fowler 2001, ODFW 2003a, ODFW 2006, Johnson 2011). However, population estimates from 2016 show that the elk population has increased across the Umatilla National Forest with a total of 20,100 elk in the Oregon portion of the Forest and 5,717 elk in the Washington population.

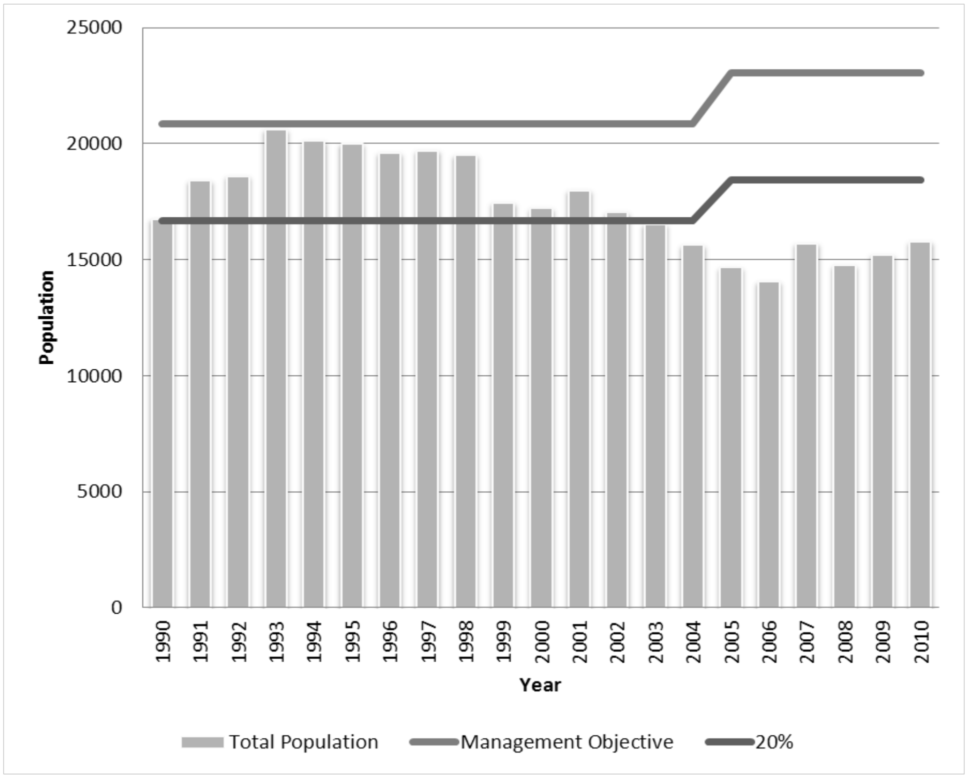

Figure 44. Estimated elk population for Oregon game management units within the Umatilla National Forest compared to the management objective for 1990-2010

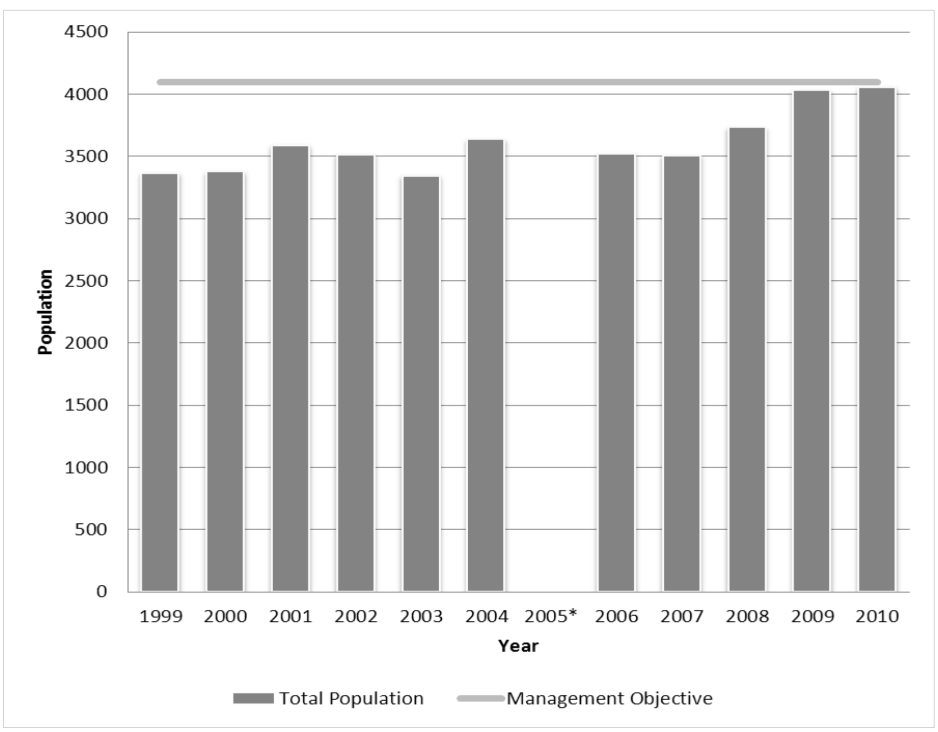

Figure 45. Estimated elk population for Washington game management units within the Umatilla National Forest compared to the management objective for 1999-2010 (asterisk indicates data is not available for at least one game management unit)

Figure 46 displays the estimated population and management objectives for those game management units that have at least 10 percent of the Wallowa-Whitman National Forest within the unit boundaries. These units include Minam, Imnaha, Catherine Creek, Keating, Pine Creek, Lookout Mountain, Snake River, Chesnimnus, Sled Springs, Starkey, Sumpter and Desolation. As of 2016, the population for these units has continued to increase and remains above the management objective at 26,472.

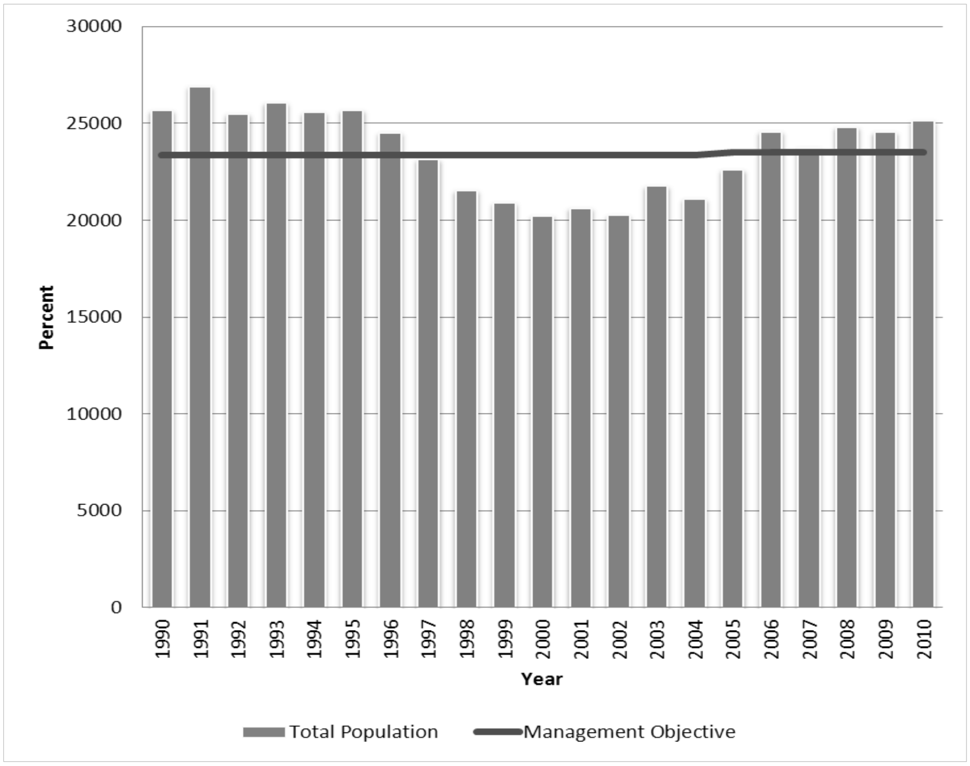

Figure 46. Estimated elk population for Oregon game management units within the Wallowa-Whitman National Forest compared to the management objective for 1990-2010

Cover and Forage - Forest stand density and structure correspond to the amount and quality of cover and forage available to elk. Analysis of elk habitat and historical range of variability analysis of vegetation suggests there has been an increase in cover and a potential decrease of quality forage (see “Forest Vegetation” section for more detail). Stand density has increased from historic levels (before 1900) and large (20 inches diameter and larger) and medium (15 to 20 inches diameter) trees across the landscape have decreased from historic levels. There has been an increase in multi-storied structure mostly in the dry upland forest potential vegetation group but also in some moist and cold upland potential vegetation groups as well. Proximity of forage to security areas (including hiding cover) has been identified as being important to maintain a socially acceptable distribution of elk (Thomas et al. 1979, Wisdom et al. 1986, Rowland et al. 2005). The distribution of forage and hiding cover (patch size and spacing) varies by potential vegetation group across the Plan Area.

Typically, elk summer in the higher elevations of the Blue Mountains and, historically, moved to the adjacent valleys during the winter. A large portion of the historic elk winter habitat in the Plan Area that is privately owned has been converted to agricultural lands, residential use, or rural

residences. As a result, elk no longer have access to or are unwanted on many of their traditional winter ranges in the Blue Mountains. In addition, private land practices of growing crops that offer high-quality forage to elk have influenced the redistribution of elk from public to private lands during non-traditional times, such as late summer. This situation reduces opportunities for hunter harvest on public lands and has led to damage to crops, fences, and pastures on private lands. Damage to private land by elk has increased markedly during the past 40 years, leading to the development by Oregon Department of Fish and Wildlife of several elk winter feeding areas on state, private, and federal lands to minimize this damage (ODFW 2006 and 2007).

Elk Security in Areas of Motor Vehicle Access – Sites with high nutritional resources are often selected by elk, but may not be used as often as expected if located near open routes used by motorized vehicles. Motorized use on Forest Service lands, during all seasons, is one of the most consistent variables in determining distributions of elk, and has increased over the past two decades. In addition, shed antler hunting in late winter/early spring has gained popularity and is a common cause of disturbance to wintering big game animals during a vulnerable time of year when there is limited available forage and inclement weather. As a result, elk may leave their winter range on National Forest lands earlier, potentially moving onto private agricultural lands, and may experience stress and decreased body condition (ODFW 2015). During hunting seasons, disturbances to elk from hunting pressure, especially the use of motorized vehicles, have pushed some elk to seek refuge on adjacent private lands where hunting is often not permitted or hunter densities and motorized uses are lower.

Table 338 displays the amount of elk security present on each forest. Elk security has been defined here as areas greater than one half mile from open motorized routes and at least 250 acres in size. The Malheur and Wallowa-Whitman provide elk security on a small percentage of the forest (17 percent and 31 percent respectively). The majority of mapped elk security on the Wallowa-Whitman is located within wilderness areas. While some of this wilderness provides high elevation summer range for elk, the amount of elk security is likely overestimated because some of it may not actually function as elk habitat due to the abundance of granite cliffs and rock outcrops that do not provide forage. The Umatilla National Forest provides a greater amount of elk security than the other two forests (43 percent), with over half of it existing outside of wilderness areas.

Table 338. A summary of existing conditions of elk security (areas greater than one half mile from open motorized routes and at least 250 acres in size) by National Forest*

National Forest	Acres of Elk Security	Acres of Elk Security excluding Wilderness	Percent of National Forest	Percent of National Forest excluding Wilderness
Malheur	286,850	216,597	17%	13%
Umatilla	606,888	336,632	43%	24%
Wallowa-Whitman	557,808	202,475	31%	11%

*Analysis was completed at the HUC10 and HUC12 scale using National Hydrologic Dataset (NHD). The analysis on the Wallowa-Whitman excluded Hells Canyon Natural Resource Area.

Effects from Alternative A to Rocky Mountain Elk

Methods – Rocky Mountain elk habitat was analyzed within the Blue Mountains during the 1990 planning effort using a habitat model developed by Thomas et al. (1979, 1988). Though the winter habitat model developed by Thomas et al. (1988) was never intended for application on

spring-summer-fall ranges, it has been widely applied on non-winter ranges. Elk management on National Forest System lands has centered on providing hiding and thermal cover (ODFW 1989, Sally 2000, Smith and Long 1987, Thomas et al. 1988, Winn 1985). A large body of research has been conducted during the 27 years since publication of these models and this research needs to be incorporated into a new model. For example, Cook et al. (2005) found little justification for retaining thermal cover as a primary component of habitat evaluation models for elk, and postulated that it may be time to shift attention towards the relationships between herd productivity and nutrition-based attributes of habitat.

The indicators used to describe elk habitat conditions in the no-action alternative include: habitat effectiveness index, cover and forage ratio, road density, and hiding and thermal cover. Habitat effectiveness index uses quality of cover, cover and forage, and open roads to indicate the effectiveness of elk habitat. Optimum habitat has a value of 1.00.

Forage is defined as areas having less than 40 percent canopy cover. Forage is available in grasslands, meadows, and riparian areas, and also within forested areas where grasses, sedges, forbs, and shrubs grow. Elk and deer also consume lichen, leaves, and bark from trees, especially during winter months. Optimum amounts of forage prepare elk and deer for winter survival.

Optimum elk habitat was defined as 40 percent cover and 60 percent forage (40:60 ratio) (Thomas 1979). Cover, in this ratio, is a combination of satisfactory and marginal cover. Satisfactory cover is greater than 70 percent canopy cover, marginal cover is 40 to 70 percent canopy cover, and forage has less than 40 percent canopy cover (Thomas et al. 1988).

The 1990 Forest Plans recognize that the habitat effectiveness index model was designed for habitat analysis at the subwatershed level or 3,000 to 15,000 acres in size but stated that for "planning purposes and analysis and comparison of alternatives, the habitat effectiveness index has been used to give a forest wide picture of habitat conditions for elk. Forestwide application of the model has masked the more subtle differences between alternatives during the 50-year planning horizon. However, generalized differences between alternatives can be addressed and are discussed below…" (USDA Forest Service 1990). The 1990 Forest Plans also recognized that the forest wide analysis did not account for the size or distribution of habitat components, but assumed that forage and cover areas were properly distributed throughout the national forest and were of usable size (USDA Forest Service 1990a). All three 1990 Forest Plans recognized that only those lands that have the potential for active management would be modeled. Since the 1990 Forest Plans were implemented, the habitat effectiveness index model has gone from being a computer model in a disk operating system (Ager and Hitchcock 1994) to a model in ArcGIS. The ArcGIS model developed for the Blue Mountains national forests was used for this analysis.

Direct and Indirect Effects – Elk populations are expected to remain abundant due to their social and economic importance, management emphasis by state wildlife agencies, and the adaptability of the species. Altering the amount of cover, forage, and security across the landscape may affect body condition and result in changes in pregnancy and parturition rates. However, those effects are likely imperceptible in relation to the effects of predation and hunter harvest that ultimately limit elk populations. While habitat quality is not currently limiting elk populations, forest management does influence the distribution of elk across the landscape. Accordingly, this discussion will focus on the effects to forage, cover, and security because those are the primary habitat components that influence elk habitat selection.

The forest plan revision effort has classified vegetation into broad categories of either forested, woodland, herbland, or shrubland. The classification is further broken out as upland or riparian.

The forested groups are classified into potential vegetation groups and densities of open or closed (Countryman 2007), which correspond to canopy covers of 40 percent or more in the dry vegetation group and 60 percent or more in the moist and cold vegetation groups. Within the Vegetation Dynamic Development Tool model, vegetation is broken into structural stages, which were then classified as whether they met the needs for hiding or thermal cover. Using these break downs could overestimate the amount of satisfactory cover compared to the original definitions (using 60 percent instead of 70 percent), but should still provide an accurate portrayal of total cover since they reflect the combination of marginal cover and satisfactory cover. However, it may also lead to an overestimate of the amount of forage, because in the moist and cold vegetation groups, open stands would be considered forage stands but could have canopy covers up to 59 percent, exceeding the definition of forage areas as being those of less than 40 percent canopy cover. Table 339 displays the results based on Vegetation Dynamic Development Tool modeling and resulting acres that would meet elk cover requirements based on the potential vegetation group.

Table 339. Percent of the forested landscape that would meet cover and forage requirements for Rocky Mountain elk by Potential Vegetation Group based on VDDT modeling*

Elk Habitat	Cold Forest (percent)	Moist Forest (percent)	Dry Forest (percent)
Hiding cover	50-60	45-55	5-10
Thermal cover	40-50	30-40	10-15
Forage	25-30	25-35	75-95

* Results from historical range of variability Vegetation Dynamic Development Tool model (years 200 to 500 average)
Dry forest thermal = 40-plus percent canopy cover
Moist and Cold forest thermal = 60-plus percent canopy cover

In order to project alternative A, the no-action alternative, the existing condition was calculated by national forest for each of the management areas previously identified as having a habitat effectiveness index or cover requirement (see project record for detailed discussion) (see Table 340). Satisfactory cover in two of three management areas within the Malheur National Forest and one of three within the Umatilla National Forest is below the desired condition, but overall cover and the habitat effectiveness index are at or above the desired condition.

For alternative A, the existing habitat effectiveness index was calculated using the existing management strata (i.e., 3a, A10, 1, etc.) and the current cover-forage map. Because projections for the future are not spatial, no attempt was made to calculate a habitat effectiveness index for future decades. The amount of cover and forage at the end of each decade was calculated for each potential vegetation group and treatment strata (Active, Reserve, Wilderness) and then proportioned back out to the management areas identified in Table A-1 (Appendix A) to produce projected cover based on potential vegetation group and management area (see Table 341). It is assumed that if open motor vehicle route density remained constant then changes in cover would reflect changes in habitat effectiveness index. A slight improvement in satisfactory cover is noted for those management areas currently below desired conditions (Table 340); however, they still remain below desired conditions. As pointed out by Powell (2005; revised 2008), it may be difficult to achieve satisfactory cover based on potential vegetation group, especially on the Malheur National Forest where dry forest types are more abundant.

Table 340. Current habitat effectiveness index (HEI) and cover percentages by national forest and management area compared to current desired condition (optimum habitat has a value of 1.0)

National Forest	Management Area	HEI_S[1]	HEI_R[2]	HEI_F[3]	HEI_C[4]	HEI	Cover Satisfactory	Cover Marginal	Cover Total	HEI	Current Cover Desired Condition Satisfactory	Current Cover Desired Condition Marginal	Current Cover Desired Condition Total
Malheur	MA 1, MA 2, MA F22	0.23	0.38	0.5	0.55	39%	3%*	30%	33%	40%	12%	20%	32%
	MA 20, MA 20B, MA 21	0.69	0.86	0.5	0.59	65%	8%	39%	47%	70%	NA	NA	40%
	MA 4A, MA F20, MA F21	0.62	0.45	0.5	0.53	52%	2%*	27%	29%	50%	10%	15%	25%
Umatilla	A10,C4,F4	0.64	0.57	0.5	0.72	60%	21%	27%	48%	60%	15%	15%	30%
	C3,C3A,C8	0.67	0.64	0.5	0.58	60%	7%*	34%	41%	79%	10%	20%	30%
	C7,E2	0.56	0.52	0.5	0.65	56%	14%	33%	47%	45%	10%	20%	30%
	E1	0.62	0.40	0.5	0.50	50%	0%	64%	64%	30%	NA	NA	NA
Wallowa-Whitman	MA 1, MA1 W	0.62	0.45	0.5	0.65	55%	15%	35%	50%	50%	NA	NA	30%
	MA 3, MA 3A, MA 18	0.62	0.56	0.5	0.65	58%	12%	29%	41%	74%	NA	NA	NA

1. HEI_S derived from the size and spacing of cover and forage areas
2. HEI_R derived from the density of roads open to vehicular traffic
3. HEI_F derived from the quantity and quality of forage
4. HEI_C derived from cover quality

*Values are below desired conditions

Table 341. Projected cover percentages by national forest, management area, and decade for alternative A compared to current desired condition

National Forest	Management Area	Cover Decade 2 Satisfactory	Cover Decade 2 Marginal	Cover Decade 2 Total	Cover Decade 5 Satisfactory	Cover Decade 5 Marginal	Cover Decade 5 Total	Current Cover Desired Condition Satisfactory	Current Cover Desired Condition Marginal	Current Cover Desired Condition Total
Malheur	MA 1, MA 2, MA F22	6%*	34%	40%	6%*	31%	37%	12%	20%	32%
	MA 20, MA 20B, MA 21	13%	40%	53%	12%	37%	49%	NA	NA	40%
	MA 4A, MA F20, MA F21	3%*	29%	32%	3%*	28%	31%	10%	15%	25%
Umatilla	A10,C4,F4	23%	22%	45%	20%	13%*	33%	15%	15%	30%
	C3,C3A,C8	8%*	24%	32%	7%*	15%	22%	10%	20%	30%
	C7,E2	20%	30%	50%	17%	21%	38%	10%	20%	30%
	E1	0	36%	36%	0%	18%	18%	NA	NA	NA
Wallowa-Whitman	MA 1, MA 1W	18%	28%	46%	15%	20%	35%	NA	NA	30%
	MA 3, MA 3A, MA 18	15%	24%	39%	13%	18%	31%	NA	NA	NA

*Values are below desired conditions

According to Table 341, even though the desire is to move towards historical range of variability, the amount of treatment that could alter cover is so small (less than one percent per year) that in the first decade, cover remains close to what was envisioned in the 1990 Forest Plan. Open motor vehicle route density is not expected to increase above what was currently modeled for the habitat effectiveness index results previously discussed (see Table 340). This, coupled with the projected cover, would result in maintaining the current habitat effectiveness indices. Therefore, no significant change in elk distribution would be expected based on Forest Service management actions.

Alternatives B, C, D, E, and F

Rocky Mountain elk were selected as a management indicator species and a focal species to represent the effects of Forest Service management on motorized disturbance and elk security. For the purposes of this analysis, elk security has been defined as areas greater than one half mile from a road and greater than 250 acres in size following the methods of Hillis (1995). Hillis recommended that an area contain a minimum of 30 percent elk security to be effective. The presence of vegetative cover and topography can ameliorate some of the impacts from roads but they were not analyzed at this landscape scale due to the difficulty in mapping an accurate layer of hiding cover. Project level planning will analyze finer scale distribution of cover and forage likely using a model that incorporates nutrition and roads variables. It is not expected that the different plan revision alternatives would have a measurable impact to the elk population given the influence of other factors such as predation and hunting. However, Forest Service actions, in particular access management, can greatly influence elk distribution. For these reasons, the following discussion will focus on the effects to elk from motorized disturbance.

Alternative B

Open motor vehicle route density would change from a standard and/or guideline in Alternative A to a desired condition depending on the management area. General Forest (MA 4A) management would have a desired condition of an open route density of 2.4 miles per square mile. The desired condition for open motor vehicle route density in motorized backcountry management areas would have a desired condition of 1.5 miles per square mile. Winter elk habitat would have a desired condition of 1.5 miles per square mile.

As compared to the no action, the percent change in area suitable for summer motor vehicle use would increase by about 7 percent on the Malheur and Umatilla NFs, and change little on the Wallowa-Whitman. Like other plan revision alternatives, Alternative B includes a guideline that would prohibit new road and trail construction within existing old forest or high elevation riparian areas.

Alternative C

The implementation of Alternative C would reduce the effects of motorized access on elk through the designated amount of area in different management areas. Desired Conditions for MA3C (Wildlife Corridor) would result in road density of 1.0 mile per square mile on about 6.5 percent of the Umatilla National Forest, about 11 percent of the Malheur National Forest, and about 10 percent of the Wallowa-Whitman National Forest. Alternative C would reduce the area designated as suitable for summer motor vehicle use by 45 percent on the Umatilla, 38 percent on the Malheur, and 53 percent on the Wallowa-Whitman national forest compared to the current condition. Like other plan revision alternatives, Alternative C includes a standard that would prohibit new road and trail construction within existing old forest or high elevation riparian areas.

Alternative C would have the greatest reduction in road density although not necessarily in the areas where forage will be created.

Alternative D

This alternative responds to requests for more public motor vehicle access. This alternative results in more areas suitable for summer motor vehicle use compared to the other alternatives as management allocations emphasize areas where active management may occur. In this alternative, the desired conditions for open motor vehicle route density in General Forest (MA-4A) is 3 miles per square mile or less.

As compared to the no action, the percent change in area suitable for summer motor vehicle use would increase by about 10 percent on the Malheur and Umatilla, and change little on the Wallowa-Whitman.

Similar to other plan revision alternatives, Alternative D includes a guideline that would prohibit new road and trail construction within existing old forest or high elevation riparian areas. Disturbance to elk from motorized travel would be highest in this alternative as compared to all other alternatives. The widespread influence of existing roads across the Plan Area would continue to negatively influence elk distribution.

Alternatives E and F

The main difference between Alternatives E and F is the amount of vegetation treatment. There is no difference in the direction for motorized access between these alternatives. However, the amount of human disturbance during vegetation treatments will be greater in Alternative E, as acres treated per year is higher.

These alternatives contain no desired conditions for open-road densities in General Forest (MA-4A), although there are designated small amounts of wildlife corridor (MA 3C) linking high quality, unroaded wildlife habitats which have a desired condition of open motor vehicle route density of less than 1.0 mile per square mile. However, the area in this management area is less than 22,000 acres on only the Umatilla and the Wallowa-Whitman combined. As compared to the no action alternative, the percent change in area suitable for summer motor vehicle use would increase by about 8 percent on the Malheur and decrease by less than 10 percent on both the Umatilla and Wallowa-Whitman.

Similar to other plan revision alternatives, Alternatives E and F include guidelines that would prohibit new road and trail construction within existing old forest or high elevation riparian areas. Disturbance from motorized travel in both of these alternatives is similar to Alternatives A and B. Risks remains high as little change is expected in motorized travel as compared to the existing condition. The widespread influence of existing roads across the Plan Area would continue to negatively influence elk distribution.

Alternatives E-Modified and E-Modified Departure

The main difference between these alternatives is the amount of vegetation treatment. The increased pace of vegetation treatments under Alternative E-Modified Departure would increase the likelihood that forage would be enhanced and desired condition reached within elk priority areas.

There is no difference in the direction for motorized access between these alternatives. However, the amount of human disturbance during vegetation treatments will be greater in Alternative E-

Modified Departure, as acres treated per year is higher. Under both alternatives, the amount of area designated as suitable for summer motorized use would decrease minimally on the Umatilla, increase by 5 percent on the Malheur, and decrease by 4 percent on the Wallowa-Whitman.

Under both alternatives, management direction for roads would include no net increase in road miles in key watersheds and a guideline to increase elk security within elk priority areas. It is anticipated that the creation of additional elk security under these alternatives would encourage elk to remain on public land where they would be accessible to the public as opposed to spending time on private land where tolerance for elk is low. Priority areas were delineated by Oregon Department of Fish and Wildlife and Washington Department of Fish and Wildlife based on the ability to affect elk distribution.

We cannot estimate future road densities within elk priority areas but they will be reduced from the current condition to meet objectives for elk security. Exact locations of road closures would depend on other competing uses of the forest and available funding.

Summary

All plan revision alternatives will move toward desired condition, though E-Modified Departure the fastest. Desired condition will provide a distribution of cover and forage that approximates historical range of variability.

Alternative C would have the greatest effect in terms of reducing motorized disturbance, potentially leading to a more desirable distribution of elk. This alternative would reduce the area designated as suitable for summer motor vehicle use by 45 percent on the Umatilla, 38 percent on the Malheur, and 53 percent on the Wallowa-Whitman National Forest compared to the current condition. However, alternative C has the least amount of vegetation treatments and would not necessarily create forage in areas where elk would utilize it. The relative benefit of this alternative would depend on prescribed fire and wildfire to create forage in close proximity to areas with less motorized disturbance.

Alternative B would result in increased negative effects from motorized disturbance, potentially exacerbating poor elk distribution. This alternative responds to requests for more public motor vehicle access. This alternative results in more areas suitable for summer and winter motor vehicle use compared to the other alternatives as management allocations emphasize areas where active management may occur. In this alternative, the desired conditions for open motor vehicle route density in General Forest (MA-4A) is 3 miles per square mile or less. As compared to Alternative A, the percent change in area suitable for summer motor vehicle us would increase by about 10 percent on the Malheur and Umatilla, and change little on the Wallowa-Whitman.

Alternatives E-Modified and E-Modified Departure would have little change in the amount of area suitable for summer vehicle use as compared to the current condition but they are expected to improve elk distribution by reducing motorized disturbance within elk priority areas. The increased pace and scale of vegetation treatments under alternative E-Modified Departure would increase the likelihood that forage would be enhanced and desired condition reached within elk priority areas. Both of these alternatives would provide a more strategic approach to elk habitat management by reducing disturbance to elk in areas most likely to influence their distribution and provide more opportunities for forage enhancement where it is most likely to be used by elk.

Mule Deer – Malheur National Forest

Similar to the discussion for Rocky Mountain elk, mule deer (*Odocoileus hemionus*) are a hunted species and do not truly meet the criteria to fulfill the purpose of management indicator species (where population change can be directly attributed to Forest Service management). Because they are important both socially and economically, mule deer were selected as a management indicator species and a focal species for the new planning effort only for the Malheur National Forest (Gouchner 2010). They were selected to represent security areas/motor vehicle use management and the herbaceous understory of early successional and opened canopy dry forest.

Mule Deer Distribution – Mule deer are extremely adaptable and can be found in all major climatic and vegetation zones of the Western United States except the arctic, tropics and extreme deserts (Boyd and Cooperrider 1986). Mule deer are native to Oregon and typically are found east of the crest of the Cascade Mountain Range. Vernon Bailey (1936) estimated Oregon's mule deer population to be 39,000 to 75,000 animals from 1926 to 1933. Mule deer populations increased through the 1930s and 1940s, peaking during mid-1950s, mid-1960s and in the mid-1970s. Fluctuations in mule deer populations can be attributed to several factors that directly or indirectly affect habitat. Drought conditions reduce forage and cover values, while severe winter weather conditions can result in large losses of deer.

Mule Deer Habitat – Oregon's deer management plan (ODFW 2003a) describes mule deer habitat in eastern Oregon:

> The most important deer habitats in Eastern Oregon are summer habitat (including areas needed for reproductive activities) and winter habitat. Preferred summer habitat provides adequate forage to replace body reserves lost during winter and to maintain normal body functions. Summer habitat also includes areas specifically used for reproductive purposes. These areas must have an adequate amount of succulent vegetation, offering highly nutritional forage. In addition, areas used for reproduction should provide isolation from other deer, security from predators and minimal competition from other ungulates. Summer habitat areas are common throughout Eastern Oregon, and can be found in areas varying from lowland agricultural lands to high elevation mountain areas.
>
> Winter habitat is found predominately in lower elevation areas of Eastern Oregon. These areas usually have minimal amounts of snow cover and provide a combination of geographic location, topography, and vegetation that provides structural protection and forage. Due to the low nutritive values of available forage during the winter, deer are forced to rely on their body reserves acquired during the summer for winter survival.

Deer habitat has changed dramatically during the last 100 years. Overgrazing by livestock during the late 1800s and early 1900s resulted in rangelands that were dominated by shrubs and forb species more favorable for deer, and populations increased (ODFW 2003b). Mule deer numbers in general have decreased during the past decade across the western United States, which is partly explained by mule deer's need for early and mid-successional habitats; habitats that are being lost due to a lack of disturbance either from fire and/or mechanical (timber harvest) treatment. Similar patterns were noted in most western states (Unsworth et al. 1999). Increased fire suppression activities allowed the encroachment of woody vegetation resulting in old decadent shrub plants that have less nutritional value for deer, the loss of desirable shrub and forage species, and the loss of forested areas that were maintained as opened canopy under natural fire regimes and provided for the growth of many important deer browse plants (Hayden et al. 2008).

Nutritional intake is a critical component of deer biology. Mule deer, like elk, are somewhat of a habitat generalist, although deer have a more selective diet, selecting higher quality forage than elk (ODFW 2003b), mostly forbs and shrubs/trees (Bartmann 1983, Findholt et al. 2004).

Findholdt et al. (2004) suggested this lack in flexibility could result in increased competition for forage resources with cattle and elk when densities of these animals are high or forage production is low. Because the emphasis currently on National Forest System lands is to manage towards historical range of variability, it was felt that mule deer would respond to the improvement in the understory in the dry forest because of the movement towards more open canopy as well as the increase in early seral stages.

Along with a concern for improving forage conditions for mule deer, is the concern of maintaining adequate security areas (Vavra et al. 2005, Wisdom et al. 2005, Wisdom et al. 2005a). Mule deer reaction to human disturbance is slightly different from elk (Taylor and Knight 2003). Deer are found closer to roads than elk on shared ranges, which may be a result of mule deer avoidance of elk (Johnson et al. 2000, Wisdom et al. 2005, Wisdom et al. 2005a). Human disturbance still results in reducing the quality of habitat for mule deer and therefore they were selected to indicate the effectiveness of motor vehicle use management and secure habitat change. Where road density is high, and security cover is low, deer will move until secure areas are found. Open-road density is often the easiest and most effective attribute to manage since hiding cover criteria may take many years to meet the desired future condition.

Effects from Alternatives B, C, D, E, and F to Mule Deer Habitat

Figure 47 displays the amount of forest structure (open forest, early successional) within the dry potential vegetation group that is anticipated to provide forage for mule deer. Mule deer use other forest types and successional stages so this figure does not capture all forage that would be available to mule deer. However, it should provide a reasonable approximation of the differences between alternatives relative to the amount of forage available over time. In the first decade, there does not appear to be a large difference between alternatives. After the first decade, alternatives D and E provide slightly more forage than the other alternatives. After four decades, the amount of forage begins to decrease under all alternatives. Alternative C provides the least amount of forage while alternative D provides the greatest amount.

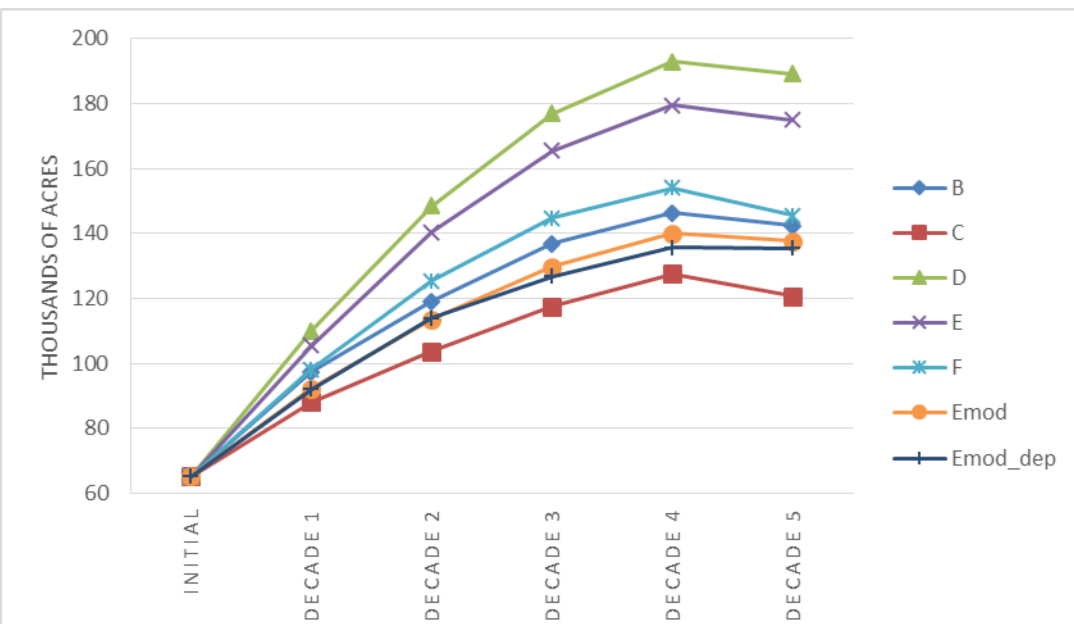

Figure 47. Acres of mule deer forage areas within the Malheur National Forest by alternative for the first five decades

On the other hand, when comparing the amount of area that provides security, Alternatives C, E modified, and E departure would provide larger areas with reduced road-related human disturbance than the other alternatives. Non-motorized use is emphasized in Alternative C by designating the most recommended wilderness (MA 1B) as well as backcountry nonmotorized (MA 3A) and wildlife corridors (MA 3C). Alternatives E-Modified and E-Modified Departure do not have wildlife corridors but they do designate elk priority areas wherein the focus will be on reducing road-related human disturbance. Finally, hiding cover within the areas to be actively managed is still important (Germaine et al. 2004). Reynolds (1969) indicated that deer need areas of heavy stocking levels (in excess of 160 square feet of basal area in immature stands) to provide escape and security cover. Cover continues to be important in the presence of human disturbance as mule deer, unlike elk, probably hide rather than flee disturbance (Vavra 2009). Alternative C would provide the greatest amount of hiding cover over time. Alternative D, which provides the greatest increase in forage, provides the least amount of hiding cover. Considering the tradeoffs between all of the alternatives, in all likelihood either Alternative E-Modified or E-Modified Departure would provide the best combination of increased forage while maintaining security areas for mule deer.

Mule Deer Population Trends – According to the Planning Rule (CFR 219.19(a)(6)), “Population trends of the management indicator species will be monitored and relationships to habitat determined. This monitoring will be done in conjunction with State fish and wildlife agencies, to the extent practicable.” The Malheur National Forests would rely on survey data collected by the Oregon Department of Fish and Wildlife (ODFW) for population numbers and trend analysis of all game species.

Vernon Bailey (1936) estimated Oregon’s mule deer population to be 39,000 to 75,000 animals from 1926 to 1933. Between 1990 and 2001, populations of mule deer were consistently below the management objective for Oregon (ODFW 2003b). This continues to be the case for mule deer within the Malheur National Forest as well (figure 48). As of 2016, there were an estimated 35,532 mule deer within the wildlife management units (Beulah, Desolation, Murderer’s Creek, Northside, and Sumpter) that encompass the Malheur National Forest.

Many mule deer ranges will no longer support historical deer population levels, in part due to reduction of habitat caused by human development and changes in land use (Mule Deer Working Group 2003). Moderate population increases may be attained in some units with careful management; however, a return to the high deer population levels present in the 1950s, 60s and 70s probably will not occur due to changes to habitat and public acceptance (ODFW 2003a).

Fluctuations in mule deer populations can be attributed to many factors including drought, which reduces forage and cover values, and severe winter weather that result in large losses of deer. Both factors can cause poor deer condition and result in lower deer survival. In contrast, years of adequate moisture and mild winters will normally result in increased deer populations. Predation has recently been acknowledged as a contributor to suppressing deer populations (ODFW 2006, Robinson et al. 2002).

Mule deer numbers are held in check by hunting, both sport and depredation. State wildlife departments can change the number of harvest permits allocated, season lengths, and sex to be harvested by game management units, all of which affect populations. Although improvement is anticipated, especially in forage conditions, for all alternatives, the total number of acres that would be treated in the dry potential vegetation group probably wouldn’t be enough to cause a

perceptible increase in populations that could be attributed to Forest Service management activities. It is assumed that mule deer populations would remain stable for all alternatives.

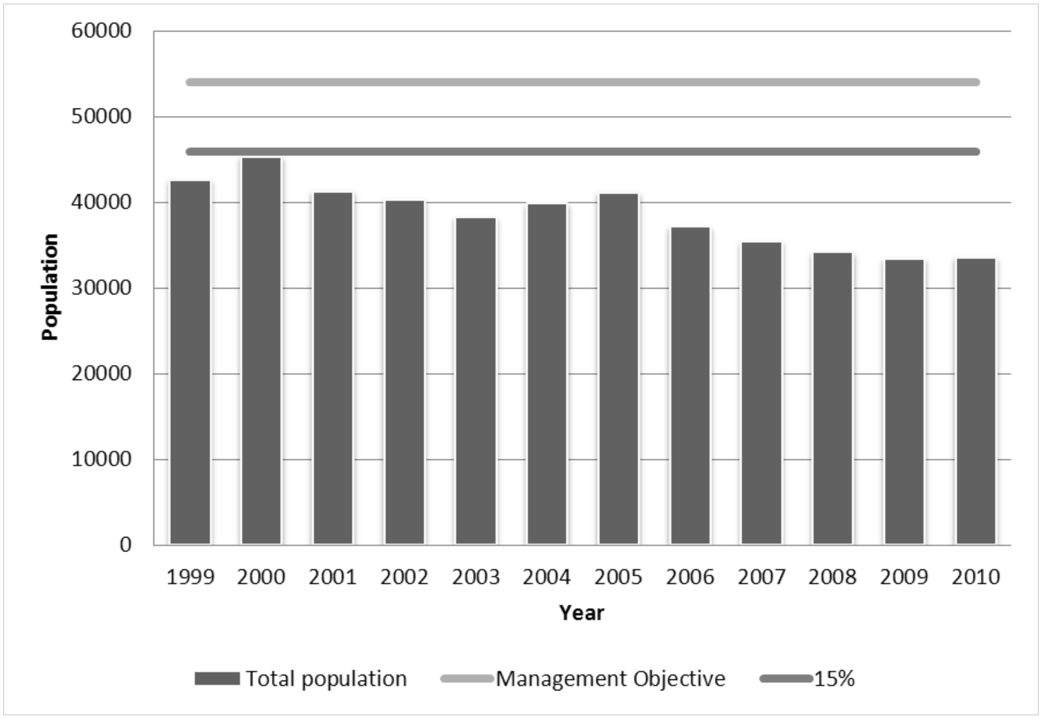

Figure 48. Estimated population of mule deer in comparison to the management objective for those units within the Malheur National Forest between 1999 and 2010

Domestic Livestock Grazing in Relation to Management Indicator and Focal Species

Forest Service regulations from the 1982 Planning Rule (36 CFR 219.20) related to forest planning and grazing states:

> In forest planning, the suitability and potential capability of National Forest System lands for producing forage for grazing animals and for providing habitat for management indicator species shall be determined as provided in paragraphs (a) and (b) of this section. Lands so identified shall be managed in accordance with direction established in forest plans.
>
> (a) Lands suitable for grazing and browsing shall be identified and their condition and trend shall be determined. The present and potential supply of forage for livestock, wild and free-roaming horses and burros, and the capability of these lands to produce suitable food and cover for selected wildlife species shall be estimated. The use of forage by grazing and browsing animals will be estimated. Lands in less than satisfactory condition shall be identified and appropriate action planned for their restoration.

Consistent with 36 CFR 219.20(a), this analysis will supplement the Rangeland Resources section to identify capable management indicator and focal species habitat on National Forest System lands and where source habitat is coincident with open domestic livestock grazing allotments. The “Rangeland Resources” section identified rangelands that were in less than satisfactory condition. National Forest System lands that exist outside open allotments, while important to management indicator species, are not addressed here as they are not affected by domestic grazing animals. For detailed analysis in this section, the following criteria must be met:

1. Management indicator and focal species source habitat must occur within open domestic grazing allotments
2. Domestic livestock grazing must pose a direct or indirect effect that either (a) is measurably contributing to the less than satisfactory condition of capable management indicator/focal species habitat within an open allotment, and/or (b) measurably threatens the ability to restore capable habitat.

The following discussion assesses each management indicator and focal species relative to these criteria: (a) and (b).

Domestic Livestock Grazing in Relation to Pileated Woodpecker – The pileated woodpecker is a management indicator species for the medium/large trees in the cool moist potential vegetation group. While pileated woodpecker habitat does occur within open allotments (criteria 1), livestock grazing is not identified as a major threat to pileated woodpecker habitat. Threats to pileated woodpecker habitat from livestock impacts are believed to be incidental and limited to localized areas where livestock tend to congregate. The majority of pileated habitat typically provides sparse or little livestock forage, an indication that grazing, should it be present, has a low likelihood of posing a risk to development or maintenance of source habitat characteristics, such as large tree development or dense conditions.

Domestic Livestock Grazing in Relation to White-headed Woodpecker – The white-headed woodpecker is a management indicator and focal species for the medium/large trees in the open and mature ponderosa pine and mixed ponderosa pine/Douglas-fir forests in the Blue Mountains. Past timber harvest has had the most significant impact on suitable habitat for white-headed woodpeckers (Wisdom et al. 2000). Large numbers of unregulated livestock in the early to mid-1900s resulted in a loss of fine fuels and created extensive areas of mineral soil that resulted in numerous successful conifer seedlings becoming established (Belsky and Blumenthal 1997, Borman 2005). Grazing is not identified as a direct risk or threat to white-headed woodpeckers (Garrett et al. 1996, Wales et al. 2011, Wisdom et al. 2000), although it may indirectly influence some of the factors affecting white-headed woodpecker source habitat (Altman 2000). For example, grazing is believed to have some localized effects to the development of younger forests and aspen stands, including incidental trampling of reproducing tree seedlings. It can also result in localized areas of increased soil erosion, and increases the potential for introduction and spread of invasive weeds and other nonnatives. However, livestock grazing does not affect the presence and abundance of large tree structure (living and dead) on the landscape. White-headed woodpecker habitat does occur within open allotments (criteria 1) within the Blue Mountains, but impacts are believed to be incidental and limited to localized areas and not a measurable threat to the restoration of capable management indicator species habitat identified as in less than satisfactory condition

In summary, while management indicator species source habitat for both the pileated and white-headed woodpecker occurs within open allotments, livestock grazing does not measurably contribute to the less than satisfactory condition of management indicator species source habitat within an open allotment, nor would it measurably threaten the ability to restore source habitat. As such, no further analysis of grazing impacts to pileated or white-headed woodpeckers will be done.

Domestic Livestock Grazing in Relation to Rocky Mountain Elk – Rocky Mountain elk were chosen as a management indicator and focal species for security areas/cover. While Rocky Mountain elk security habitat does occur within open allotments (criteria 1), livestock grazing is

not identified as a major threat to security habitat. Elk are an adaptable species and somewhat of a generalist in their use of habitat and forage (Cooperrider 2002). Regarding their habitat overall, and specifically foraging habitat, many studies have indicated that grazing management can have either positive or negative impacts on their habitat (Wambolt et al. 1997, Halstead et al. 2002, Torstenson et al. 2002, Findholt et al. 2004, Damiran 2006, and Vavra 2009). Elk habitat does occur within open allotments (criteria 1) and it is believed that livestock grazing across the range of the species within the Blue Mountains may have some effects to the quantity and quality of forage available to elk, although not to security habitat.

Domestic Livestock Grazing in Relation to Mule Deer – Mule deer were selected to represent forage conditions in the dry forest understory and, to a lesser degree, security areas and motor vehicle use management. Mule deer, like elk, are considered a habitat generalist, although deer have a more selective diet and tend to select higher quality forage than elk (ODFW 2003b). At times this less flexible diet, which comprises mostly forbs and shrubs/trees (Bartmann 1983, Findholt et al. 2004), could result in increased competition for forage resources with cattle and elk (Findholt et al. 2004). As with elk, several studies have indicated that grazing management can have either a positive or negative effect on mule deer habitat (Damiran 2006, Findholt et al. 2004, Kie et al. 1991, Loft et al. 1987, Torstenson et al. 2006, Vavra 2009, Willms et al. 1980). Mule deer habitat does occur within open allotments (criteria 1), and it is believed that livestock grazing across the range of the species within the Blue Mountains may have some effects to the quantity and quality of forage available to mule deer.

In summary, habitat for both Rocky Mountain elk and mule deer occurs within open allotments and livestock grazing may contribute to less than satisfactory conditions of their habitat. Although some differences do exist in their responses to livestock grazing, for the most part deer and elk are very similar. As such, both will be analyzed together, assuming the responses would be the same unless specifically noted.

The dominant forage of cattle, elk, and deer includes shrubs, forbs and grasses (Findholt et al. 2004). The time of year and the order in which species (cattle, elk or deer) graze determines what resource is utilized (Coe et al. 2005). Findholt et al. (2004) concluded the following: 1) elk will utilize more grasses and sedges than forbs and shrubs in pastures not previously grazed by cattle; 2) elk will utilize more resources and more evenly than deer and cattle; 3) elk responded to a decline in available lichens by increasing their consumption of grasses and sedges, which increased the competition between cattle and elk; and 4) the competition between elk and cattle also increased during the late summer. Skovlin et al. (1968) found that both elk and mule deer used pastures not grazed by cattle more than any of the cattle-grazed pastures, with use declining as cattle stocking rate increased. They found less of an effect by cattle on mule deer than on elk. Coe et al. (2005) found that deer and elk alike selected different resources when cattle were present and may also move out of pastures where cattle had been released.

Not all lands that are suitable as forage areas for elk and deer are subjected to domestic livestock grazing. However, wild ungulate use is not restricted to these areas and therefore must be accounted for on all lands, even those managed for domestic livestock grazing. As with domestic livestock, meadows and grasslands provide the most efficient forage areas for elk (Ager et al. 2003, Collins and Urness 1983, Wickstrom et al. 1984,), especially in early spring, while overall forage is limited on summer range. Also, elk may leave an area being grazed by cattle, but will often return to a pasture after cattle leave (Yeo et al. 1993).

Nutritional status is a key factor in the welfare of individual animals and hence elk herd productivity (Johnson et al. 2005). Therefore, the quantity and quality of forage available for deer and elk populations is an important factor in determining habitat effectiveness (Beck et al. 1997, Roloff 1997). Especially important is the quality of forage available in the fall to store fat reserves for winter and in the spring to replace fat reserves and satisfy gestation requirements (Cook et al. 2004). Damiran (2006) indicated that moderate grazing by livestock and elk has little effect on the subsequent nutrient intake rate of cattle, deer, and elk in mixed-conifer rangelands during the late summer in northeast Oregon. It is important to keep in mind that it is the plant community and the health of the plants themselves that must be the ultimate measure of use by herbivores (Vavra 1992). Utilization levels that do not exceed long-term utilization of 40 percent probably do not have negative effects on plant health. As such, it is anticipated that those alternatives with utilization levels of 40 percent or less will continue to provide quality forage for elk and deer. Alternative C would be the best at providing for the needs of elk and deer, followed by Alternatives E-Modified and E-Modified Departure. As Vavra and Riggs (2010) point out, interactions of ungulates and their environment is very complex, so other aspects such as timing of grazing can also affect the quality and quantity of forage available for deer and elk (Clark et al. 2000, Westenskow-Wall et al. 1994). Also, on some public lands, developments, such as roads, trails, and campgrounds, and disturbance from recreational and management activities, increasingly influence available forage by causing elk and deer to abandon forage areas due to disturbance (Wisdom et al. 2005, Wisdom et al. 2005a).

According to the range analysis (see “Livestock Grazing and Grazing Land Vegetation” section), an evaluation of monitoring data shows a recovery in terms of native species composition beginning in the mid-1900s and continuing until about the turn of the century. Since 2000, improvement has slowed for reasons that are unclear; however, it may be related to factors such as weather (e.g., precipitation timing and amounts) or the cumulative effects from other impacts such as fire (both exclusion and occurrence), forested vegetation management (including canopy cover, invasion into historical grassland or shrublands, as well as opening of forest canopy in some areas), and could even be somewhat related to climate change.

Some sites may or may not improve with improved grazing management. For example, some upland bunchgrass plant communities have been invaded by cheatgrass and/or invasive species (Quigley and Arbelbide 1997) and since currently there is not a feasible means of eliminating cheatgrass, these sites may have passed the threshold where recovery is achievable. It has also been suggested that early spring or late fall use by wild ungulates, such as elk or deer, are known to impact bunchgrass communities by heavy and improperly timed grazing such that the more palatable, and early growing (e.g., cool-season or C-3) species have been negatively impacted (Briske and Richards 1994).

Riparian areas are also of concern as they not only provide forage areas for both elk and deer, but also a source of hiding cover for deer (Loft et al. 1987). Monitoring data conducted as part of the PACFISH/INFISH Biological Opinion effort (Archer et al. 2009) have indicated that, on a broad scale, there has been a recovery for many of the parameters most closely associated with livestock grazing effects. Analysis of this data for the Blue Mountains national forests also indicates a favorable trend in many of the parameters important to deer and elk; however, this has not occurred to the extent that sites fully meet desired conditions. The rate of recovery may also not be in the time frame desired. Additionally, it is recognized that localized areas may be lagging behind in recovery, but it is anticipated that they will be dealt with at the project level.

A broad scale assessment of available forage was completed by calculating pounds per acre of forage for each plant association group. The basic data for this was derived from the plant association guides completed for the Blue Mountains (Johnson 1987 and Johnson and Clausnitzer 1992). It should be remembered that these estimates are coarse, and even though a single number was used to calculate potential forage, the reality is that production can be variable and influenced by site specifics, such as the seral stage of vegetation being analyzed or annual variations due to precipitation. A further caveat is that total herbaceous production was estimated, which probably overestimates what would actually be palatable forage.

In summary, the available information indicates an excess of forage production that is capable of meeting the current and projected needs for permitted livestock, as well as for large wild ungulate populations, and for providing for the basic needs of the plants, soils, and other rangeland resources. This analysis was conducted at the landscape scale and it is recognized that there may be site-specific conflicts that are believed to be generally small in scope and extent. Project planning will deal with potential conflicts at that scale.

Considering the previous discussion, it would appear that proposed stocking levels for any of the alternatives would leave sufficient residual biomass available for wild ungulates on lands considered suitable foraging areas. However, livestock do not make uniform use of suitable rangeland, but rather graze in a pattern that varies in a gradient from higher use in the more preferred lower slopes and near water, to near zero use in areas with steeper slopes or farther from water. As such, actual utilization across suitable range may vary from the proposed utilization levels to zero percent, but would average perhaps 20 to maybe 40 percent.

Alternative C would have the least impact on suitable habitat for elk and deer because the least amount of suitable foraging habitat coincides with proposed domestic livestock grazing areas. The proposed utilization level is below the threshold where utilization levels may impact the forage base, indicating that few if any site specific areas would be negatively impacted. Other plan revision alternatives would have similar effects from domestic livestock grazing because proposed utilization levels are not expected to reduce the health of the forage base. Although Alternative D has more acres subject to domestic livestock grazing, the proposed utilization level is at or below the risk level of plant health reduction.

Cumulative Effects to Management Indicator Species

The clearest concept of a management indicator species would be a species highly associated with a specific habitat type (Niemi et al. 1997) and home ranges small enough to be influenced mostly by management activities on National Forest lands (Hayward et al. 2004, Landres et al. 1988, Owen 2010). Few species, however, are unaffected by events that are not controlled by the Forest Service. As such, the cumulative effects described below have the potential of influencing populations of those species.

Several of the species analyzed as management indicator species for the various forest plan alternatives include game species managed by state wildlife departments. These departments can change the number of harvest permits allocated, season lengths, and sex to be harvested, which can affect population levels. Cumulative effects not only include harvest regulations of management indicator species, but also changes in harvest regulations for predators of management indicator species. For example, prohibiting the use of dogs to harvest mountain lions in Oregon has led to an increase in mountain lion populations, which may affect some local elk and deer populations (ODFW 2006). Access to other non-federal and federal ownerships during

the hunting season can also influence populations. Most game management units contain multiple ownerships, which influences the ability to achieve population objectives.

The elk priority areas in Alternatives E-Modified and E-Modified Departure identify areas where reducing road-related human disturbance will be a priority throughout the life of the plan. These areas were delineated in conjunction with state wildlife agencies with the intent of shifting elk distribution to public land where they are available to the public instead of occupying private land where they can become a nuisance to farmers, ranchers and others. However, the extent to which elk remain on public land is also influenced by factors outside the control of the Forest Service. Elk distribution will also be influenced by the quality of forage available on other lands as well as the extent to which landowners and state wildlife management agencies discourage elk through deterrents such as fencing, hazing, and damage hunts.

Some of the species spend a portion of their time outside of the National Forest boundary. The northern goshawk and Lewis's woodpecker, are partial migrants (Wisdom et al. 2000) that most likely winter off of the national forest. Still others occupy habitats that occur abundantly on private lands, like the white-headed woodpecker, which inhabits ponderosa pine or the northern flicker which inhabits juniper. Vegetation management on other ownerships has not necessarily featured the retention of preferred habitat attributes for these species (large trees and snags) in the past, and may not in the future. Wisdom et al. (2000) estimated a 62 percent reduction in source habitat for the white-headed woodpecker from historical conditions in the Columbia River Basin and a reduction of 79 percent in the Blue Mountains.

Other species like the northern (American) three-toed woodpecker and pileated woodpecker have much of their preferred habitat on lands administered by the Forest Service. Wisdom et al. (2000) estimated a 21 percent decrease in source habitat basin-wide for the pileated woodpecker, but found more than a 100 percent increase in source habitat in the Blue Mountains Ecological Recovery Unit from historical to current times, indicating that few cumulative effects would be anticipated from lands under private, state, or other federal administration within the Blue Mountains.

Other Species

Bighorn Sheep

The analysis of effects to bighorn sheep did not rely on the surrogate species approach due to the predominant influence of disease on their population viability. There are two subspecies of bighorn sheep in Oregon and Washington: California (*Ovis canadensis californiana*) and Rocky Mountain (*Ovis canadensis canadensis*). Both subspecies, often referred to generically as "wild sheep", inhabit the Plan Area, and the state wildlife agencies responsible for their management have been careful to keep the subspecies separate according to generally accepted historical distributions for the respective subspecies. Historically, California bighorn sheep occurred in central and southeastern Oregon, the eastern slope of the Cascade Range in Washington, portions of British Columbia, California, Nevada, southwestern Idaho, and possibly western Nebraska. Rocky Mountain bighorn sheep historically occurred in northeastern Oregon, central Idaho, Montana, Wyoming, southwestern Alberta, southeastern British Columbia, eastern Utah, and Colorado, and possibly portions of New Mexico (Toweill and Geist 1999). Both subspecies were extirpated from Oregon and Washington by the early 1900s, with the exception of the last few Rocky Mountain bighorns that died in Oregon around 1945. The current range represents an increase in occupied habitat since the 1940s as a result of reintroductions. However, much of the

historical range is still unoccupied. These species are not well distributed within the Plan Area, but were chosen as a surrogate species to represent grass/shrub environment.

Primary Threats to Species Viability

A viable population is one that survives fluctuations in demographic, genetic, and environmental conditions and maintains its vigor and potential for evolutionary adaptation over a long period of time (Soule' 1987). Generally, the Forest Service's role in wildlife management is focused on conserving, protecting, or manipulating habitat to ensure that habitat exists, and is available and capable of supporting viable populations of native and desired non-native wildlife species. Bighorn sheep represent an exception in that the Forest Service not only administers a substantial amount of habitat for this species, but also administers a livestock grazing program that can directly or indirectly affect bighorn populations through the potential for disease transmission. Although several factors affect bighorn sheep populations and habitat, the potential for disease transmission from domestic sheep or goats represents the most significant factor that can be effectively managed on National Forest System lands.

Wildfire and invasive nonnative plants can alter habitat for bighorn sheep. Fire can rejuvenate forage and create connectivity between patches of source habitat. The exclusion of fire can reduce available habitat as plant succession reduces sight distance, and changes the context and effectiveness of escape terrain. Invasive plants can replace native vegetation, rendering foraging areas unusable for bighorn sheep. Predators, primarily cougars, can focus on bighorn sheep and suppress recruitment at a localized scale. These and other factors combine to alter the habitat and population dynamics of bighorn sheep, but the Forest Service has limited capability to influence these factors. The Forest Service has direct administrative control over the potential for disease transmission from permitted domestic livestock to bighorn sheep. Although sheep and goats associated with hobby farms, pets, pack animals, and weed control also represent possible disease vectors, the Forest Service has no or limited management authority over these activities. Therefore, the focus of this analysis is around the potential risks from permitted domestic sheep grazing. The use of domestic goats for recreational packing is also addressed.

Disease Transmission from Domestic Sheep and Goats

Technically "diseases" are not transmitted; rather, pathogens (bacteria, viruses) are what actually get exchanged from a shedding host to a recipient host. Disease may result from the way a recipient host's immune system responds to the insult of the pathogen(s). In the case of bighorn sheep, the pathogens are generally bacteria to which bighorns are naïve, and pneumonia is the disease that results as the recipient host's immune system produces mucus in an effort to expel the pathogens. This over-production of mucus impedes proper respiratory function and pneumonia takes hold, which is often fatal to bighorn sheep. However, for ease of discussion, this process is commonly referred to as "disease transmission."

Some aspects of bighorn sheep behavior contribute to the probability that they will make contact with or associate with domestic sheep or goats when occupying the same landscapes. First is the basic social or herding behavior of members of the subfamily *Caprinae* (includes goats and sheep). The tendency to seek out and associate with animals of similar form and appearance creates an attraction between sheep and goat species (Onderka et al. 1988, Schommer and Woolever 2001). The reasons behind this attraction is not as important as the fact that it occurs, and such behavior often results in close association when a domestic sheep or goat gets separated from its herd or owner and encounters wild sheep.

The second behavior that contributes to association in the wild is "foraying" by bighorn sheep. A foray is any short-term movement by a bighorn sheep from and back to an established home range. Both sexes exhibit foraying behavior, which can occur at any time of the year. However, the large proportion of forays occur with males during the breeding season (rut) from early November through mid-December. Foray probabilities were determined from more than 54,000 telemetry locations in the Hell Canyon complex, and showed that rams are greater than nine times more likely than ewes to embark on forays. Of the individuals that exhibited foraying behavior in the Hells Canyon data set, 90 percent were rams and 10 percent were ewes (Carpenter et al. 2014). On Bureau of Land Management (BLM) administered lands in Idaho, bighorn sheep were documented to have traveled nearly 50 miles, including through towns and across major rivers (Coggins 2002). Telemetry data has shown that desert bighorn sheep regularly cross the broad valleys that separate the majority of desert mountain ranges (Krausman et al. 1996, Schwartz et al. 1986). Although many examples of longer forays exist, the forays from the Hells Canyon data set generally did not exceed thirty-five kilometers. Figure 49 and Figure 50 are graphs showing the distribution of summer forays by distance, for ewes and rams respectively.

The summer season is when authorized domestic sheep and goats would be on allotments within the Plan Area; therefore, this analysis focuses on the summer season. The probability of association between domestic sheep or goats and wild sheep increases where suitable habitats are well connected and these connections overlap with areas used by domestic sheep or goats (Gross et al. 2000, Singer et al. 2000). To further complicate this scenario, a foraying bighorn sheep may contract pathogens from an encounter with a domestic sheep or goat and then visit multiple herds of bighorns before returning to its home range. Such behavior can lead to a single contact between a bighorn sheep and a domestic sheep or goat resulting in disease moving rapidly through multiple bighorn herds in a population.

Evidence that association or contact between domestic sheep and bighorn sheep leads to respiratory disease in bighorn sheep is overwhelming (Clifford et al. 2009, Foreyt et al. 1994, Silflow et al. 1993). Studies at Washington State University (Besser 2014) confirmed that certain disease causing pathogens can be transmitted via aerosol, but the maximum distance that these pathogens can travel through air or how long they can remain viable outside an animal host is not fully understood. The terms "contact" and "association" are used interchangeably because many epizootics have resulted following observed "association" between domestic sheep or goats and bighorn sheep, but actual "contact" was not observed.

A variety of viruses, bacteria, and parasites such as lungworm, contagious ecthyma, and scabies affect bighorn sheep, but most of these do not lead to population-level all-age die-offs, otherwise referred to as epizootics. "Epizootic" simply denotes a disease that is temporarily prevalent and widespread in an animal population. Bacteria of the family *Pasteurellaceae* (*Pasteurella multocida, Mannheimia haemolytica*, and *Bibersteinia trehalosi*) and *Mycoplasma ovipneumoniae* are the most common pathogens associated with population-level die-offs (Martin 2006, Schommer and Woolever 2001, Herndon et al. 2011, Wood et al. 2017). These specific pathogens are not endemic to wild sheep in North America, thus the immune systems of wild sheep are naïve to them. The result is an immuno-response that frequently leads to pneumonia. Domestic sheep and goats commonly carry these pathogens without showing symptoms of disease or other negative consequences (WAFWA 2014).

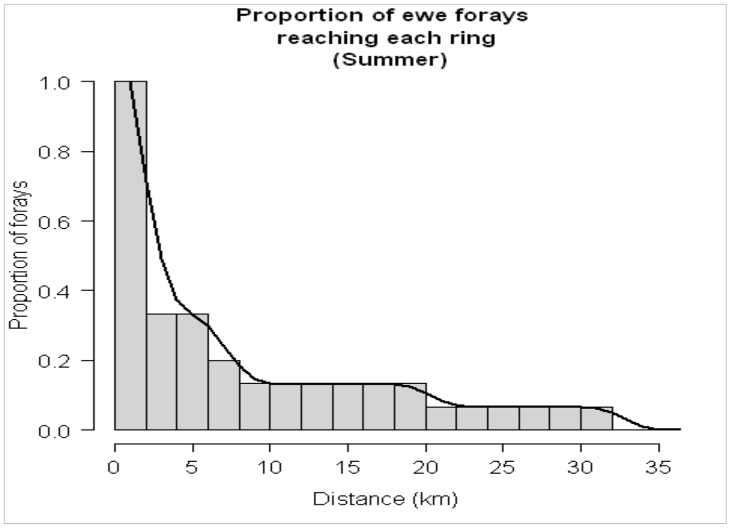

Figure 49. Proportion of summer forays by ewes by distance from core home range

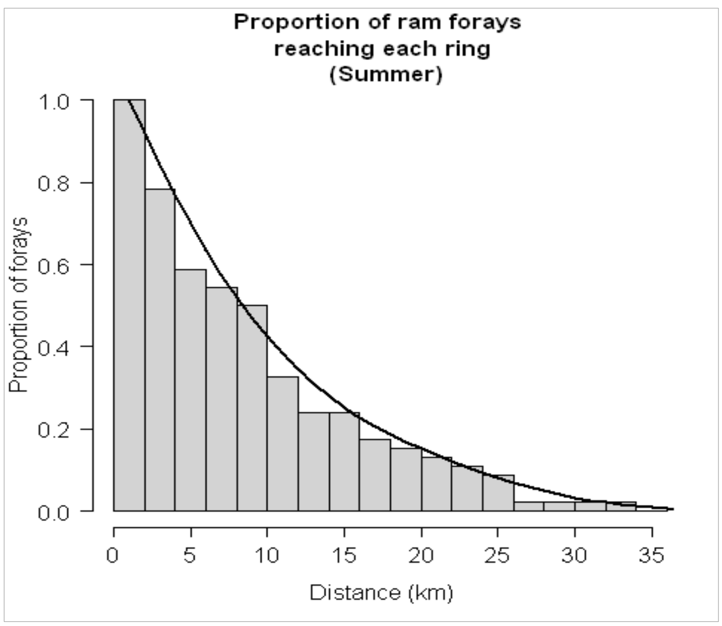

Figure 50. Proportion of summer forays by rams by distance from core home range

More than 327 bighorn sheep in a 30 square mile area in Hells Canyon died when exposed to *Pasteurella multocida* and *Mannheimia haemolytic*a that was most likely carried by a feral goat (Dassanayake 2009, Onderka et al. 1988, Schommer and Woolever 2001). Both *P. multocida* and *M. haemolytica* were isolated from a feral goat and a bighorn sheep found in close proximity to where the Hells Canyon (1995 and 1996) bighorn sheep pneumonia epizootic began (Cassirer et al. 1998, Dassanayake et al. 2008, Weiser et al. 2003). It should be noted that the organism called *Pasteurella haemolytica* has been renamed *Mannheimia haemolytica*, but because much of the scientific literature uses the old nomenclature, the names should be considered synonymous. Several authors (Dassanayake et al. 2008, Silflow et al. 1993, Srikumaran et al. 2007, Weiser et

al. 2003) have demonstrated that bighorn sheep are highly susceptible to *P. multocida* and *M. haemolytica* strains found in domestic sheep and goats.

In some bighorn epizootics, pathogens isolated from the respiratory tracts of dead or near death bighorn sheep including parainfluenza-3 (PI-3) virus, respiratory syncytial viruses (RSV), *Mycoplasma ovipneumoniae*, and lungworms (*Protostrongylus* spp.) are believed to have contributed to disease (Rudolph et al. 2007; Spraker et al. 1986). In experiments, *M. ovipneumoniae* has been shown to predispose bighorn sheep to *M. haemolytica* pneumonia. When *M. ovipneumoniae*–free domestic sheep were commingled with bighorn sheep, the bighorn sheep survived at unprecedented rates.

Tom Besser of Washington State University has determined that *Mycoplasma ovipneumoniae* frequently functions as a precursor to other bacterial pathogens that result in pneumonia in bighorn sheep. Besser et al. (2012) analyzed diagnostic specimens taken from nine bighorn sheep herds that were undergoing a die-off from pneumonia and nine apparently healthy bighorn sheep herds. *M. ovipneumoniae* was detected as a predominate member of the bacterial flora in all nine of the pneumonic herds, and was absent in all nine of the apparently healthy herds. *M. ovipneumoniae* was the only pathogen detected at significantly higher prevalence in animals from epizootics than in animals from unaffected healthy populations, and was the most consistently detected pathogen within each epizootic (Besser et al. 2012). These data provide evidence that *M. ovipneumoniae* plays a primary role in wide spread pneumonia in bighorn sheep.

Bighorn Sheep Population Viability

When addressing population viability it is common to consider a minimum population size, sometimes referred to as a non-viable number. The concept of species or population viability is complex, and involves many factors in addition to a minimum number of individuals in a population. These factors include, but are not limited to demographic composition of the population such as gender ratio and age structure; birth and death rates; immigration and emigration rates; mortality factors; sensitivity to various environmental stressors; quality and quantity of habitat; and the species' sensitivity and population response to stochastic events. Of these multiple components of species viability, the one that is most directly associated with the management of National Forest System lands is the risk of transmission of disease-causing pathogens from domestic sheep and goats. The Forest Service has no or little authority or ability to influence the other components of species viability (demographic composition, gender ratio, birth and death rates, and other factors).

Singer et al. (2000, 2001) suggests that bighorn sheep herds that drop below 30 individuals are unlikely to recover, and very likely to go extinct. Singer et al. (2001) used observations from 41 epizootics in bighorn sheep to estimate a 5 percent chance of a herd surviving when pre-epizootic herd size was fewer than 50 animals. Berger (1990) examined extinction rates for 122 bighorn sheep populations in California, Colorado, Nevada, New Mexico and Texas, and concluded that herds with fewer than 50 individuals would likely go extinct within 50 years. Zeigenfuss et al. (2000) relates a contiguous source habitat patch size of 32 square kilometers (approximately 7,900 acres) to an estimated minimum viable population of 125 adults.

Adult population estimates (2016) for the four California bighorn herds within the Blue Mountains Plan Area are currently above both the minimum viability benchmarks of 30 and 50 individuals (see Table 342) suggested by Singer (2000, 2001) and Berger (1990) respectively, but two herds, Burnt River and McClellan are below the minimum population of 125 suggested by Zeigenfuss (2000). Each of these four herds are isolated from each other, with only a slight

possibility of exchange between the Aldrich and McClellan herds. Aldrich and McClellan herds are separated by less than 10 miles, much of which is heavily forested and unlikely to be traversed by bighorn sheep. No non-human facilitated exchange between Aldrich and McClellan herds has been documented (ODFW pers. com. 2017).

Although each of the four California bighorn herds contain greater than 50 individuals, they remain isolated from each other, and vulnerable to local extirpation based on relatively small herd size and vulnerability to epizootics. These herds' vulnerability to disease is not from permitted grazing by domestic sheep or goats on National Forest System lands. The risks are associated with factors largely outside of management authority and control of the Forest Service. Pets, 4-H animals, and hobby/farm flocks of domestic sheep and goats on private lands represent the greatest risks to these bighorn sheep herds.

The thirteen Rocky Mountain bighorn herds (Table 342) within the Blue Mountains Plan Area differ from the California subspecies in that their distribution is largely connected by source habitat, with at least some level of genetic exchange occurring between many of the herds. The 2016 adult population estimates indicate that 8 of the 13 herds are below the suggested minimum viable threshold of 50 (Berger 1990), and one additional herd with 54 adults, only slightly above the suggested threshold. Using the non-viable number of 30 adults suggested by Singer et al. (2000, 2001) and Carpenter et al. (2014), 4 of the 13 herds contain fewer than 30 individuals, and one additional herd has just 31 individuals. Only the Lookout Mountain herd exceeds the minimum population size of 125 suggested by Zeigenfuss (2000).

Based strictly on herd size and geographic distribution of the Rocky Mountain bighorn population, there is a high likelihood that this population is not viable. Viability is further compromised by poor lamb recruitment due to persistent respiratory disease in several of the herds. Figure 51 uses the Sheep Mountain bighorn herd, now extirpated, as an example of population trend when a disease event leads to an initial all-age die-off (approximately 1998), followed by multiple years of little or no lamb recruitment. The Sheep Mountain herd was estimated at ninety individuals prior to the introduction of disease that killed approximately sixty percent of the herd. The herd dropped to below thirty individuals and experienced little to no lamb recruitment over the next decade until the herd became extirpated. The last few individuals (only females) in the Sheep Mountain herd were captured and used as research subjects. Given the tenuous condition of these herds, any management actions that result in exposure to disease-causing pathogens could lead to the extirpation of herds, contributing to a decline toward extinction of the Hells Canyon bighorn sheep population.

Another means of predicting species persistence, or viability is to model population change over time using current population estimates and survival rates of lambs and ewes. The survival of rams is much less important because a relatively small number of rams is capable of performing the mating necessary for reproduction, thus the reproductive potential of a population exists largely with the adult female cohort. Population trajectory was modeled for two Rocky Mountain bighorn sheep herds within the Plan Area. Each herd was modeled under two disease scenarios, healthy and stochastic health (considering predicted exposure to disease).

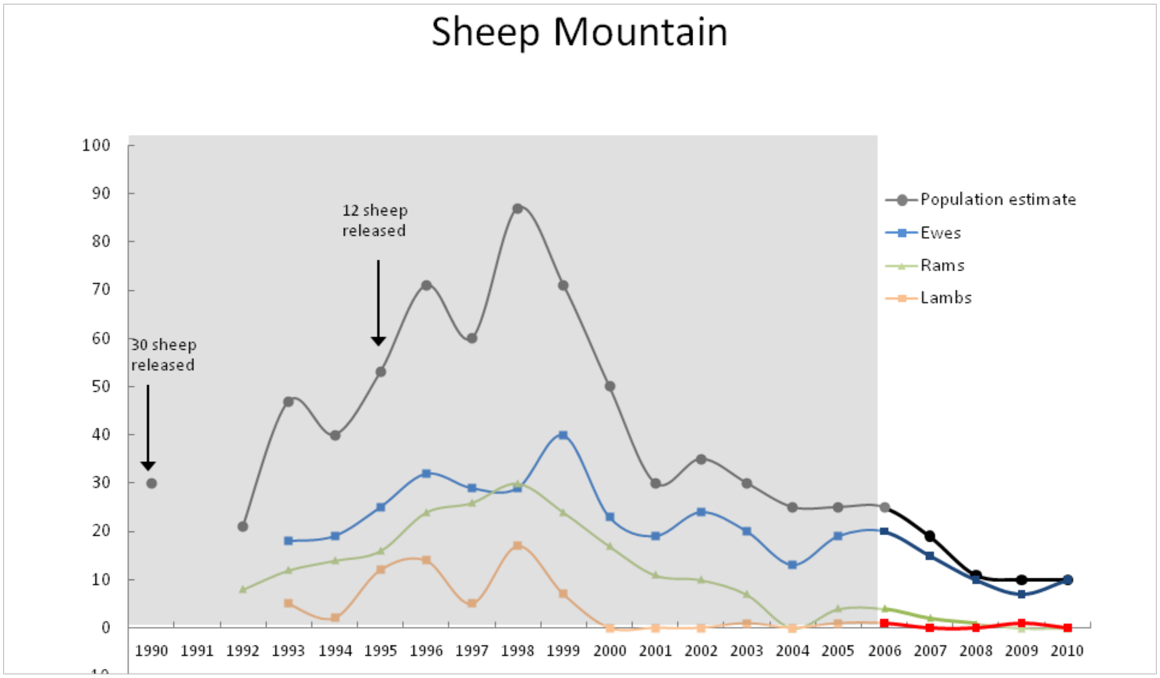

Figure 51. Annual population estimations for the Sheep Mountain bighorn sheep herd (extirpated)

Figure 52 and figure 53 show the predicted population growth for the Lostine and Wenaha bighorn herds, respectively, under the two health scenarios. These figures illustrate that these example herds would predictably increase over time in the absence of disease, and conversely would trend toward extirpation in the presence of disease. These example herds inhabit significantly different land types. The Lostine herd inhabits subalpine and alpine mountain tops and the Wenaha herd inhabits steep canyons characterized by rock, grasslands, shrub lands, and stringers of conifer forests.

The interaction of disease outbreaks in bighorn sheep populations with other stressors (both disease and otherwise) is poorly understood. Recent research suggests that the complex interactions of disease agents themselves increases uncertainty in diagnosis and may also predispose bighorn sheep to secondary disease events. Additional research is needed on disease spillover at the wildlife/livestock interface, but it is reasonable to expect bighorn sheep are susceptible to diseases caused by multiple pathogens that result in multiple disease cycles (e.g. *Mycoplasma ovieneumoniae*, viruses, internal and external parasites, and other bacterial taxa). Additional stressors, which can reduce the resistance of bighorn sheep to disease-causing pathogens, include overcrowding on limited range; harassment and mortality by dogs or other predators; encroachment by humans; severe weather events (Bunch et al. 1999); parasitism; poor nutrition; other human disturbances such as roads, habitat degradation, and noise; breeding behavior; and the presence of other wildlife (Foreyt 1998 Monello et al. 2001, Garde et al. 2005, USDA 2010a).

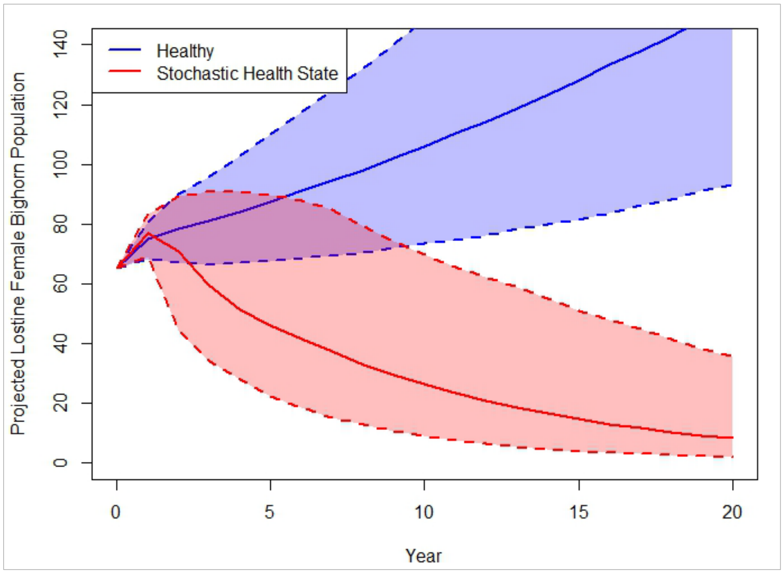

Figure 52. Lostine bighorn sheep herd population trajectory under two health scenarios

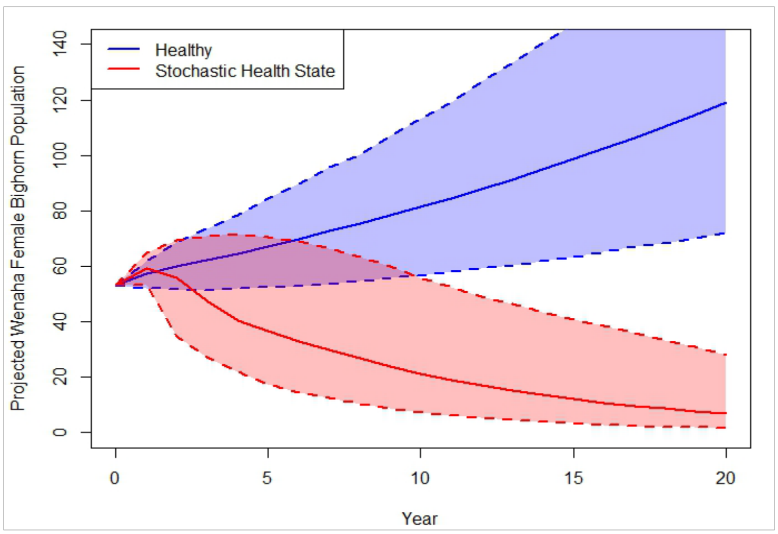

Figure 53. Wenaha bighorn sheep herd population trajectory under two health scenarios

Genetic Considerations for Species Viability - As a result of die-offs and suppressed reproduction from persistent disease, the genetic diversity in bighorn sheep herds has been drastically reduced (Schommer and Woolever 2001). The sources of reintroduced bighorn sheep into the Plan Area represent a "founders bottleneck" in regard to genetic diversity in the meta-population (Hilty et al. 2012). Reduced genetic diversity is a factor that can limit population viability over the long-term. Another population characteristic that is limiting viability of bighorn sheep in the Plan Area is the relatively small and isolated herd distribution, particularly for the California subspecies. Multiple herds or subpopulations comprise a meta-population. According to the WAFWA Wild Sheep Working Group (Brewer et al. 2014) population viability depends upon the persistence of the subpopulations. "Populations of bighorn sheep that are few in number and geographically isolated are more vulnerable to extirpation than larger populations, due to

lower genetic diversity and an inability to replace individuals lost from a variety of causes (Brewer et al. 2014)." California bighorn sheep within the Plan Area exist in four isolated herds, with no contact between herds or immigration from outside the Plan Area. The Aldrich and McClellan herds are the closest to each other, but no contact or exchange between these herds has been documented by ODFW (Torland pers. com. 2017). The Aldrich Mountain, McClellan, Burnt River and Potamus herds are isolated from all other bighorn herds. Their relatively small population size and complete isolation from other herds make each of them vulnerable to local extirpation from disease or other unpredictable events.

Table 342. Bighorn sheep herd names and 2016 population estimates within the Blue Mountains forest plan revision analysis area

Bighorn Sheep Subspecies and Herd Name*	State	2015 Adult Population Estimate (ODFW)	National Forest (Nearest to bighorn herd)
California *O.c. californiana*			
Aldrich Mountain	Oregon	150	Malheur
Burnt River	Oregon	87	Wallowa-Whitman
McClellan	Oregon	82	Wallowa-Whitman
Potamus	Oregon	147	Umatilla
Rocky Mountain *O.c. canadensis*			
Asotin	Washington	46	Umatilla
Black Butte (Upper Joseph Canyon)	Washington & Oregon	24	Umatilla
Mountain View	Washington	30	Umatilla
Tuncannon	Washington	31	Umatilla
Bear Creek (Minam)	Oregon	54	Wallowa-Whitman
Lookout	Oregon	181	Wallowa-Whitman
Lostine	Oregon	68	Wallowa-Whitman
Lower Hells Canyon (includes Downy Saddle)	Oregon	40	Wallowa-Whitman
Lower Imnaha	Oregon	76	Wallowa-Whitman
Muir Creek	Oregon	19	Wallowa-Whitman
Upper Hells Canyon	Oregon	7	Wallowa-Whitman
Upper Saddle (Saddle Creek & Hat Point)	Oregon	43	Wallowa-Whitman
Wenaha	Oregon & Washington	62	Umatilla

* The Canyon Creek herd identified in the Oregon Bighorn Sheep and Rocky Mountain Goat Management Plan (2003) is not addressed here because this herd no longer exists, and there are no plans to reestablish it. The Sheep Mountain herd is also extinct.

The Rocky Mountain bighorn sheep population within the Plan Area functions as a meta-population made up of many relatively small herds that experience minor amounts of inter-herd contact, typically during the rutting season. The Lookout and Tucannon herds are effectively isolated from other herds in the Hells Canyon complex, although contact between these and other herds is possible. The bighorns that inhabit portions of the Eagle Cap Wilderness are not known to come into contact with herds in Hells Canyon, but images of rams have been captured on trail cameras in the southern end of the Eagle Cap wilderness, in atypical habitat. These images

confirm that movements through atypical habitat (forested) occur, which may lead to contact between distant herds (Ratliff pers. com. 2016). Habitat within the major canyons (Grande Ronde, Wenaha, Snake, Lostine, and Joseph) is highly permeable and contiguous, which facilitates interaction between many of the herds within the Hells Canyon complex. Relatively small herd size is also a concern for long-term viability in the Rocky Mountain subspecies. The connectedness of the Hells Canyon herds is positive relative to genetic variability and overall distribution, but negative relative to the ability of disease causing pathogens to travel between herds. Some level of connectedness is evidenced by the presence of the same genetic strain of *M. ovipneumoniae* within all bighorn herds in the Hells Canyon complex, except for the Lookout and Tucannon herds (Cassirer pers. com. 2017).

Bighorn Sheep Source Habitat

Bighorn sheep prefer open habitats on rocky slopes, ridges, rimrocks, cliffs, and canyon walls adjacent to meadows or grasslands (Verts and Carraway 1998). Alpine and subalpine vegetation are typically summer range for this species. Risenhoover et al. (1988) suggested that the three major components of bighorn sheep habitat are visibility, escape terrain (cliffs, talus areas), and forage. Wisdom et al. (2000) placed both the Rocky Mountain and California bighorn sheep in family group 22, which are residents of high elevation alpine and subalpine communities.

The definition of source habitat is borrowed from Wisdom et al. (2000), which are those characteristics of macro-vegetation that contribute to stationary or positive population growth. Source habitats are distinguished from habitats simply associated with species occurrence; associated habitats may or may not contribute to long-term population persistence. Although habitat is not considered a limiting factor for bighorn sheep in the Plan Area, habitat is an integral part of the risk of contact analysis. The Forest Service, in cooperation with the Bureau of Land Management, developed a risk of contact tool that uses escape terrain defined by Sappington et al. (2007) and combined with a horizontal visibility component (USDA Forest Service 2010) to define source habitat. These Forest Plans utilize existing vegetation polygon and current vegetation survey stake point summaries (Countryman 2009). Only summer source habitat is analyzed for risk of contact, because summer is the only season when domestic sheep are grazed on allotments administered by the Forest Service within the Plan Area. Details of the summer source habitat model is available from the planning record.

The amount of source habitat is the same for all alternatives because source habitat is delineated from biophysical characteristics without consideration of disease risks. Range capability for grazing by domestic sheep is based on the capability of the vegetation to produce forage that could be utilized by domestic sheep. The area that is “suitable” for grazing by domestic sheep is a subset of the “capable” category. Range suitability for grazing by domestic sheep is largely based on the risks of inter-species association between domestic sheep and bighorn sheep. Table 343 displays the amount of acres that are suitable for grazing by domestic sheep on each national forest within the Plan Area, by alternative.

Those alternatives that would provide the most summer source habitat in areas identified as unsuitable for domestic sheep grazing and the fewest acres of rangelands considered suitable for domestic sheep grazing are considered to contribute the most to bighorn sheep population persistence (see Table 343). The Wallowa-Whitman and the Umatilla National Forests have large areas identified as unsuitable for domestic sheep grazing for all alternatives (see domestic sheep range suitability maps in Appendix G). Although the table displays acres of rangelands suitable for domestic sheep grazing, not all of those acres are currently being or would be grazed by

domestic sheep. Many of the acres that could be grazed by domestic sheep are currently in cattle allotments, and although technically they could be grazed by sheep, a site-specific analysis would be required to change the class of livestock permitted on the allotment.

Effective Separation: **Assessing Risk of Contact** – There is broad agreement within the scientific community that spatial and temporal separation between bighorn sheep and domestic sheep and goats is the most prudent management approach to reduce the possibility for transmission of disease-causing pathogens to bighorn sheep (WSWG 2012). The Wild Sheep Working Group, a committee sanctioned by the Western Association of Fish and Wildlife Agencies, defines effective separation “as spatial or temporal separation between wild sheep and domestic sheep or goats to minimize the potential for association and the probability of transmission of diseases between species” (WSWG 2012). Attempts to define effective separation in terms of a set distance or “buffer” have been applied with questionable success. A “buffer” or simple distance approach is fraught with inconsistencies and not supported by peer-reviewed literature. Buffers fail to consider the permeability of the landscape for bighorn sheep or domestic sheep or goats, fails to account for man-made or natural landscape features that can effect animal movements, and does not consider foray probabilities of bighorn sheep under various herd structure scenarios. O’brien et al. (2014) describe a process to calculate the probability of a foraying bighorn ram or ewe (and both genders combined) contacting a domestic sheep grazing allotment boundary. The methods described by O’brien is commonly referred to as a “risk of contact model” or “risk of contact tool”. This method relies on three components: (1) bighorn sheep core herd home range estimation; (2) foray analysis; and (3) contact analysis.

Although empirical data are currently lacking on recommended disease outbreak intervals that are necessary for long-term population persistence, a moderate level of outbreak events (that is, 0.25) would lead to an average outbreak period of 50 years, has been suggested as a benchmark (FS/BLM 2015). The Wild Sheep Working Group has suggested that results of the risk of contact tool may be interpreted as follows: “Given the potential severity of die-off resulting from interspecies contact, we recommend management scenarios that allow for disease free intervals of at least 50 years. If we assume a moderate probability of contact with an allotment resulting in an interspecies contact that will result in a disease transmission outbreak event (0.25), then we would need to see a rate of contact of less than 0.08 contacts per year (or less than 0.8 contacts per decade).”

None of the existing domestic sheep allotments within the Plan Area intersects core herd home range of bighorn sheep. The rate of contact for all active domestic sheep allotments in the Plan Area ranged from 0 to 0.019 contacts per year, all less than the suggested threshold of 0.08 contacts per year (Lyons et al. 2016). The complete risk of contact analysis is located in the planning record.

The risk of contact between foraying bighorn sheep and domestic sheep or goats is influenced by the number of bighorn sheep in a herd, the gender ratio of the bighorn sheep herd, the proximity of domestic sheep or goat use areas (allotments) to bighorn sheep herds, the distribution of bighorn sheep source habitats across the landscape, and the frequency and distance of bighorn sheep forays. It is important to note that the risk of contact analysis used here only estimates the probability of foraying bighorn sheep reaching an allotment. It does not consider risks associated with lost or wandering domestic sheep or goats. Nor does it predict actual contact or disease transmission between domestic sheep or goats and bighorn sheep. An important assumption underlying the risk of contact analysis is that the probability of association and disease transmission increases substantially when a foraying bighorn sheep’s contact with an allotment or

use area coincides with domestic sheep or goat presence. Once a foraying bighorn sheep contracts a pathogen, there is a high likelihood that it will either return to its core herd home range or associate with other bighorn herds as it moves across the landscape. This behavior increases the chances of a disease causing pathogen to move between individuals and herds.

Table 343. Relative ranking of alternatives by national forest based on proportion of bighorn sheep summer source habitats not available for domestic sheep grazing (protected) and rangelands remaining suited for domestic sheep grazing. A ranking of 1 would pose the least risks to bighorn sheep, a ranking of 5 would pose the greatest risks to bighorn sheep.

Alternative	Summer Source Habitat Protected (acres)	Rangeland Unsuitable for Domestic Sheep Grazing (acres)	Relative ranking for providing separation between domestic and bighorn sheep
Malheur			
A	N/A	Identified at site-specific scale	4
B	88,623	468,790	2
C	97,703	1,340,727	1
D	88,623	468,790	2
E	88,623	468,790	2
E-Modified	88,623	468,790	2
E-Modified Departure	88,623	468,790	2
F	88,623	468,790	2
Umatilla			
A	N/A	N/A	4
B	471,112	909,007	2
C	502,922	1,204,247	1
D	450,753	872,988	3
E	450,753	872,988	3
E-Modified	450,753	872,988	3
E-Modified Departure	450,753	872,988	3
F	450,753	872,988	3
Wallowa-Whitman			
A	N/A	N/A	4
B	1,141,520	1,652,291	2
C	1,152,864	1,856,157	1
D	1,137,402	1,644,455	3
E	1,137,402	1,644,455	3
E-Modified	1,137,402	1,644,455	3
E-Modified Departure	1,137,402	1,644,455	3
F	1,137,402	1,644,455	3

Alternatives are ranked based on the potential for interspecies contact as modeled using a risk of contact tool (FS/BLM 2015). Domestic sheep allotments within 35 kilometers of a bighorn sheep core herd home range were analyzed. Thirty-five kilometers is used because it is the distance that explains the large majority (more than 99 percent) of forays by both ewes and rams in the Hells Canyon telemetry data set. Table 343 displays relative ranking of alternatives based on the

calculated number of contacts per year. It is assumed that the greater the likelihood of contact, the greater the potential for disease transmission and resulting disease outbreaks. Alternative C is the only alternative that would reduce interspecies contact to a level of almost zero. It is assumed that any overlap or intersection between bighorn sheep core herd home ranges and domestic sheep allotments will result in disease transmission between the species. A risk of contact analysis where core herd home range overlaps or intersects a domestic sheep allotment would produce the results of “intersects” rather than a probability of contact. This is because there is no distance separating core herd home range and the allotment.

Risks of Disease Transmission from Pack Goats

Pack goats are domestic goats that are used as pack animals. Dedicated pack goat owners/handlers cite that the husbandry practices, training, and manner of use associated with pack goats warrant differentiation from domestic goats owned or used for other purposes. Other purposes include pets, 4-H animals, weed control, milk and meat, or any purpose other than pack animals. Although empirical evidence is limited, the current state of knowledge suggests that pack goats likely represent a much lower risk of contracting, carrying, and transmitting *Mycoplasma ovipneumoniae* than other classes of domestic sheep or goats (Besser pers. com. 2016). Although domestic goats are physiologically capable of carrying and transmitting various pathogens and parasites that are harmful to bighorn sheep, *M. ovipneumoniae* is the focus of current research due to the compelling evidence that identifies it as an integral part of epizootics in bighorn sheep.

According to Dr. Tom Besser’s research and his synthesis of others’ work, the genetic strain of *M. ovipneumoniae* found in nearly all bighorn sheep die offs is a “domestic sheep strain” that appears to be host specific to sheep species. There is also a genetic strain of *M. ovipneumoniae* that appears to be host specific to goat species, and has been much less virulent in bighorn sheep in penned studies (when domestic goats and bighorn sheep of known disease status are comingled in captivity). Although the goat strain of *M. ovipneumoniae* appears to be less virulent in bighorn sheep than sheep strains, at least one well-documented example indicates that the goat strain of *M. ovipneumoniae* is capable of causing significant bighorn sheep disease in a field setting. Heller Bar, Washington in lower Hells Canyon experienced a pneumonia event in bighorn sheep that resulted in mortality of 30 percent of the herd, and losses of all lambs in subsequent years. A goat strain of *M. ovipneumoniae* was confirmed in this disease event. However, this documented disease event pales in comparison to the dozens of disease outbreaks associated with domestic sheep strains of *M. ovipneumoniae*.

Husbandry practices are the first steps in rearing of pack goats that reduces the incidence of *M. ovipneumoniae.* Goats intended for packing are typically removed from their mother at birth or shortly thereafter, and bottle fed by the owner/handler. Early separation contributes to two important factors that reduces risks of pack goats transmitting pathogens: (1) if the mother is carrying *M. ovipneumoniae,* separating the new born from its mother eliminates the opportunity for *M. ovipneumoniae* to be spread from mother to newborn, and (2) early separation enhances the opportunity for the young goats to imprint on their human owners/handlers. Imprinting on human owners/handlers may decrease the inherent social attraction between pack goats and other animals. This is important for pack goat owners/handlers to more effectively maintain close control over their pack goats in any setting.

Dr. Besser advises wildlife and land managers with responsibilities for bighorn sheep to regard domestic goats as a potential source of *M. ovipneumoniae* that can result in significant mortality

in bighorn sheep, "…even while recognizing this risk appears to be considerably lower than that posed by domestic sheep." Pack goats appear to present significantly different degrees of risk for bighorn sheep compared to domestic goats used for other purposes. For example, goats used for weed control are used in much higher numbers and present greater opportunity for escape and subsequent contact with bighorn sheep. Pack goats are typically used in small (six or less) numbers and are less likely to escape control of their owner/handler than goats used for weed control. Although there seems to be a low prevalence of *M. ovipneumoniae* in pack goats, there are risks of pack goats contracting *M. ovipneumoniae* through co-mingling with other domestic sheep or goats.

Dr. Maggie Highland, research veterinarian with the USDA Agriculture Research Service, Animal Disease Research Unit (Pullman, WA), has sampled 576 domestic goats (419 pack goats and 157 other goats) from 83 separate premises in 13 states. This study has not been published, but the preliminary results are relevant to these Forest Plans. In summary, *M. ovipneumoniae* was confirmed in 38 (6.6 percent) of the 576 goats sampled. The *M. ovipneumoniae* positive goats were limited to five (6 percent) of the 83 premises sampled. Of the 38 goats that were positive for *M. ovipneumoniae*, 90 percent of them were less than a year of age, 77 percent were less than six months of age. Dr. Highland's study represents the largest sample size of any study that specifically investigated the prevalence of *M. ovipneumoniae* in pack goats. This study contributes to the prior sparse body of literature that supports the notion of low, but not zero prevalence of *M. ovipneumoniae* in pack goats.

Keeping pack goats from contact or association with bighorn sheep is a prudent management approach considering: (1) non-zero prevalence of *M. ovipneumoniae* in pack goats; (2) the uncertainty around pack goats co-mingling with other domestic sheep and goats; (3) other pathogens and parasites of concern that may exist; and (4) the social attraction that exists between members of the sheep and goat families.

Forest Plan standard BHSM-2S states, "The use of recreational pack goats shall not be authorized in occupied bighorn sheep habitat or where effective separation from bighorn sheep cannot be reasonably maintained." This standard applies to special use permits or requests to conduct any commercial activity involving pack goats within occupied bighorn sheep habitat or in areas where effective separation from bighorn sheep cannot be reasonably maintained. These Forest Plans do not include direction that addresses recreational pack goat use within the Plan Area.

Bighorn Sheep - Effects from the Alternatives

Direct and indirect effects focus on the risks associated with disease transmission from domestic sheep or goats to bighorn sheep. One way of quantifying these risks is by determining the probability of bighorn sheep leaving their core herd home range, contacting a domestic sheep allotment when domestic sheep are present on the allotment, and returning to their core herd home range. This is referred to as risk of contact, and this analysis is described in more detail earlier in this section. The risk of contact tool used in this analysis is recognized as the best available science, utilizing the best available data to produce quantitative results. This process is documented in a paper by O'Brien and others (2014) published in the Wildlife Society Bulletin. The limitations of this risk of contact tool are explained earlier in this section. Risk of contact results are meaningful at the bighorn herd and grazing allotment scale, and serve as a surrogate to actual association and transfer of disease-causing pathogens from domestic livestock to bighorn sheep. The potential effects to bighorn sheep from authorizing domestic sheep or goat grazing are indirect effects, because the predicted transfer of pathogens and subsequent spread to other

bighorn sheep would occur later in time than the Records of Decision for these plans or the authorizing of domestic sheep or goat grazing.

Cumulative effects are considered at the national forest scale, and focus on the relative area that is identified as unsuitable for domestic sheep and goat grazing, by national forest, and the amount of bighorn sheep source habitat within these unsuitable delineations. The potential cumulative effects from invasive weeds and disease vectors from land ownerships other than National Forest System lands cannot be quantified in a reliable or repeatable manner, although these factors are recognized as important considerations in the management of bighorn sheep habitat and populations. Activities from all land ownerships that can affect bighorn sheep are considered in cumulative effects, but are often not possible to quantify due to the uncertainty of scale, intensity, and duration. An example is the treatment and subsequent decrease in invasive weeds in bighorn sheep habitat. Effective control of invasive weeds represents a positive effect to bighorn sheep. However, it is impractical to predict which landowners/managers will engage in invasive weed treatments, and if they do, to what scale and over what timeframe it would occur.

Potential disease vectors exist on private lands that surround the National Forest System lands. These vectors are sheep and goats that occur in small farm flocks, 4-H animals, pets, and other sources. The presence of these animals is dictated by desires of private landowners and can change over time as land ownership changes, or interest in keeping sheep and goats changes. These unknowns make it impractical to quantify the risks from these potential disease vectors. However, the risks are acknowledged in how state wildlife agencies plan and prioritize where to attempt restoration of bighorn sheep to unoccupied habitat. The Strawberry Mountain Wilderness on the Malheur National Forest is an example of an area that contains a substantial amount of bighorn sheep source habitat, but is not considered as a viable option for bighorn sheep re-establishment. An earlier attempt to restore bighorns in the Strawberry Mountain Wilderness failed due to disease. Oregon Department of Fish and Wildlife has since made the decision to not attempt re-establishment of bighorn sheep there because disease risks persist on private lands bordering the area.

Alternative A

Direct and Indirect Effects – This alternative will not result in direct effects to bighorn sheep because direction in Forest Plans does not implement actual changes to the environment. However, site-specific environmental analyses that follow direction in the Forest Plans may result in actual changes to the environment. Continuing under the current management direction will not change the risk of domestic sheep or goats associating or coming into contact with bighorn sheep. These risks could change if bighorn sheep herds expanded into currently vacant habitat, but such a shift would not result from direction in a Forest Plan. A shift in habitat use by bighorn sheep would represent changed conditions, and may trigger a new environmental analysis if the shift compromised effective separation between a domestic sheep allotment and a bighorn sheep herd.

Alternative A would continue the existing domestic sheep grazing allotments, which all have a risk of contact well below the 0.08 probability threshold (see Table 344).

Table 344. Estimated annual contact rates for bighorn sheep herds relative to active domestic sheep allotments in the Plan Area*

Bighorn Sheep Herd and Active Allotment	Single Ram	Single Ewe	All Rams	All Ewes	All Herd
Bear Creek					
Davis Creek	7.10E-05	9.28E-06	5.68E-04	4.27E-04	0.001
North End	5.00E-05	5.00E-06	3.99E-06	2.38E-04	0.001
Mud Creek	3.79E-05	4.96E-06	3.04E-04	2.28E-04	0.001
Spring Mountain	6.43E-06	1.13E-07	5.14E-05	5.22E-06	<0.001
Black Butte					
Mud Creek	1.69E-03	4.68E-05	1.85E-02	6.09E-04	0.019
Davis Creek	3.15E-04	9.48E-06	3.47E-03	1.23E-04	0.004
Lostine					
Davis Creek	3.90E-04	9.04E-06	8.57E-03	4.16E-04	0.009
Mud Creek	1.06E-04	6.51E-06	2.32E-03	2.99E-04	0.003
Lower Hells Canyon					
Davis Creek	1.09E-05	5.71E0-7	1.20E-04	1.66E-05	<0.001
Mud Creek	5.08E-07	9.87E-09	5.59E-06	2.60E-07	<0.001
Lower Imnaha					
Davis Creek	7.59E-05	5.98E-06	1.44E-03	3.41E-04	0.002
Mud Creek	3.32E-06	4.34E-07	6.30E-05	2.47E-05	<0.001
Mountain View					
Mud Creek	5.98E-04	2.09E-05	1.44E-03	5.44E-04	0.003
Davis Creek	5.32E-05	3.28E-06	2.13E-04	8.52E-06	<0.001
Muir Creek					
Davis Creek	3.29E-05	3.41E-06	2.96E-04	3.41E-05	<0.001
Mud Creek	1.10E-06	2.09E-08	9.93E-06	2.09E-07	<0.001
Wenaha					
Mud Creek	1.28E-03	3.02E-05	1.41E-02	1.54E-03	0.016
North End	6.87E-04	2.50E-05	7.56E-03	1.29E-03	0.009
Davis Creek	1.37E-04	3.67E-06	1.50E-03	1.87E-04	0.002

* Includes only active domestic sheep allotments within 35kilometers of bighorn sheep herds

The primary difference between Alternative A and the plan revision alternatives is that the current management direction does not restrict the conversion of livestock class to sheep, or restrict the establishment of domestic sheep to areas where effective separation would be maintained. It is possible for a line officer to require effective separation in a site-specific environmental analysis based on the mandate to utilize the best available data and science. However, there is no direction associated with Alternative A that requires effective separation.

This alternative does not restrict the use of pack goats within or near occupied bighorn sheep habitat. This use occurs in two categories that are relevant to these Forest Plans. First is the unregulated, “recreational pack goat use” that occurs in the Plan Area. This activity occurs with no requirement for a permit or other administrative requirements or oversight. Second is the “authorized pack goat use” which involves the commercial use or renting of pack goats for which a special use permit or other authorization would be required. Currently there are no commercial activities involving pack goats in the Plan Area. Alternative A would not restrict authorized pack

goat use within the Plan Area. Although evidence exists that suggest the risk of disease transmission from pack goats to bighorn sheep is substantially less than from domestic sheep, the risk is not zero. The risk of harmful pathogens being transmitted from pack goats to bighorn sheep is low, but the ramifications to bighorn sheep could be severe if transmission were to occur. For this reason, Alternative A represents the highest risk to bighorn sheep from pack goats than any of the other alternatives, because there are no considerations on where and when pack goats can be used relative to occupied bighorn sheep habitat.

Cumulative Effects – Alternative A would continue authorizing grazing by domestic sheep at the current level, in the current locations. According to the results of the Risk of Contact tool, the current domestic sheep allotments represent an acceptable level of risk when just considering the probability of foraying bighorns contacting allotments. Additionally, this alternative relies on inconsistent (the three Forests identify unsuitable range in different ways) and site-specific delineation of areas unsuitable for domestic sheep grazing. This could result in a greater chance that grazing by domestic sheep or goats could be authorized at some in the future that would increase the risk of disease transmission to bighorn sheep. This contrasts with the other alternatives in that they delineate suitable and unsuitable areas for domestic sheep grazing for the entire Plan Area based on risks to bighorn sheep. This forest-wide delineation represents a safety measure that would prevent the future establishment or conversion of grazing allotments to domestic sheep where effective separation from bighorns may not be reasonably maintained.

Alternative A does not address disease risks from pack goats, has not identified areas unsuitable for domestic sheep grazing for the entire Plan Area, and it does not include direction that ensures effective separation between domestic sheep or goats and bighorn sheep. Therefore, Alternative A represents the highest level of risk to bighorn sheep compared to the plan revision alternatives.

Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F

Direct and Indirect Effects – Direct and indirect effects are described in terms of the risk of contact between bighorn sheep and existing domestic sheep allotments. These risks do not differ between plan revision alternatives since none of the alternatives change the existing domestic sheep grazing allotments. Table 344 contains the risk of contact results for four domestic sheep allotments (Davis Creek, North End, Mud Creek, and Spring Mountain) relative to eight bighorn sheep herds (Bear Creek, Black Butte, Lostine, Lower Hells Canyon, Lower Imnaha, Mountain View, Muir Creek, and Wenaha). These allotments are the only ones located within 35 kilometers of a bighorn sheep herd. The rationale for limiting the risk of contact analysis to these is explained earlier in this section.

The Mud Creek sheep allotment represents the highest risk of contact between bighorn sheep and the allotment boundary, with a 0.019 probability of contact from the Black Butte bighorn herd, and a 0.016 from the Wenaha bighorn herd. These results are well below the recommended threshold of 0.08. The Mud Creek sheep allotment management plan has gone through a relatively recent environmental analysis that documents the supporting rationale for when and where domestic sheep are grazed in relation to the nearest bighorn sheep herds. The current low level of risk is expected to continue unless bighorn sheep in the Black Butte or Wenaha herds begin to expand their range closer to the allotment boundary.

The remaining allotments pose extremely low risks of contact, with probabilities ranging from < 0.001 to 0.009. This translates to 0.09 contacts per decade. The Application of the Bighorn Sheep Risk of Contact Model on the Blue Mountains national forests: Final Report (Lyons et al. 2016)

analyzed all existing allotments, regardless of livestock class (sheep, cattle, horse) or status (active, vacant, closed). These results are for illustrative purposes and may be useful in future site specific planning should domestic sheep allotments require new environmental analyses due to changed conditions (eg. bighorn sheep range expansion).

Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F all address the use of pack goats in the same manner through a standard requiring that pack goats only be authorized where effective separation from bighorn sheep can be reasonably maintained. This standard only applies to pack goat use that would occur under a permit or other type of authorization generally required due to group size or involvement of commercial activity (guided trips, rental of pack goats, etc.). These alternatives offer a measure of insurance that authorized pack goat use will unlikely present disease transmission risks to bighorn sheep. From this standpoint, all of the plan revision alternatives present fewer risks to bighorn sheep than Alternative A.

None of the plan revision alternatives restricts the use of recreational pack goats (not associated with a permit or authorization) within the Plan Area, including occupied bighorn sheep habitat. These alternatives are equal to Alternative A in this regard. Although the risk of disease transmission from pack goats is low, the risk is not zero, and a single transmission event has the potential to start an all-age die-off in bighorn sheep.

Alternative B – Cumulative Effects

On the Malheur National Forest, Alternative B identifies 468,790 acres as unsuitable for domestic sheep grazing, which includes 88,623 acres of bighorn sheep source habitat. Alternative B identifies 1,652,291 acres as unsuitable for domestic sheep grazing on the Wallowa-Whitman National Forest, which includes 1,141,520 acres of bighorn sheep source habitat. For the Umatilla National Forest, this alternative identifies 909,007 acres as unsuitable for domestic sheep grazing, which includes 471,112 acres of bighorn sheep source habitat. This alternative provides the second greatest area where grazing by domestic sheep or goats will not be authorized, thus resulting in the second lowest probability that disease from authorized livestock will be transmitted to bighorn sheep. Table 343 compares all plan revision alternatives in terms of acres of source habitat for bighorn sheep protected through designation as unsuitable for domestic sheep grazing.

Alternative C – Cumulative Effects

On the Malheur National Forest alternative C identifies 1,340,726 acres as unsuitable for domestic sheep grazing, which includes 97,703 acres of bighorn sheep source habitat. Alternative C identifies 1,856,157 acres as unsuitable for domestic sheep grazing on the Wallowa-Whitman National Forest, which includes 1,152,864 acres of bighorn sheep source habitat. For the Umatilla National Forest, this alternative identifies 1,204,247 acres as unsuitable for domestic sheep grazing, which includes 502,922 acres of bighorn sheep source habitat. This alternative provides the greatest area where grazing by domestic sheep or goats will not be authorized, thus resulting in the lowest probability that disease from authorized livestock will be transmitted to bighorn sheep. Table 343 compares all plan revision alternatives in terms of acres of source habitat for bighorn sheep protected through designation as unsuitable for domestic sheep grazing.

Alternative C is the same as Alternatives B, D, E, E-Modified, E-Modified Departure, and F in regard to the use of pack goats within or near occupied bighorn sheep habitat.

Alternatives D, E, E-Modified, E-Modified Departure, and F – Cumulative Effects

On the Malheur National Forest these alternatives identify 468,790 acres as unsuitable for domestic sheep grazing, which includes 88,623 acres of bighorn sheep source habitat. There are 1,644,455 acres of unsuitable for domestic sheep grazing on the Wallowa-Whitman National Forest, which includes 1,137,402 acres of bighorn sheep source habitat. For the Umatilla National Forest, this alternative identifies 872,988 acres as unsuitable for domestic sheep grazing, which includes 450,753 acres of bighorn sheep source habitat. These alternatives provide the third greatest area where grazing by domestic sheep or goats will not be authorized on the Wallowa-Whitman and Umatilla National Forests, but is the same as Alternative B for the Malheur National Forest. These alternatives would result in the third lowest probability that bighorn sheep would associate with authorized domestic sheep or goats.

None of these alternatives would likely lead to population declines or range constrictions for bighorn sheep. Although Alternatives B and C would result in slightly less risks to bighorn sheep populations, the risks associated with all Alternatives are such that species viability is not likely to be compromised. This assertion of low risk is based on: (1) the exceedingly low probability of contact from current domestic sheep allotments; (2) the areas identified as unsuitable for domestic sheep or goat grazing; and (3) application of the management standards for grazing by domestic sheep or goats.

Sage-grouse

Greater sage-grouse are a Regional Forester's Sensitive Species. Like the other sensitive species, sage-grouse were included in the surrogate species analysis conducted by Wales et al. (2011). The species representing the woodland/grassland/shrub family is the sage thrasher (table 95). Unlike the other sensitive species, sage-grouse are addressed here individually because of their unique conservation efforts and high public interest.

Sage-grouse are considered a sagebrush obligate species as virtually all studies of sage-grouse have identified the bird's dependence on large, woody sagebrushes (*Artemisia* spp.) for food and cover during all periods of the year (Dalke et al. 1963, Connelly et al. 2000, Connelly et al. 2004). Sage-grouse breed on sites called leks (strutting grounds) which are typically used year after year. Breeding habitats are normally sage-brush dominated shrub-steppe, consisting of large, relatively contiguous stands of sage-brush (Connelly et al. 2011). Much of the original sage-grouse habitat has been permanently lost to agricultural development and urban areas (Leu and Hanser 2011, Pyke 2011) and the remaining habitat ranges from high quality to no longer adequate.

Source Habitat Description

According to Schroeder et al. (1999), sage-grouse use a wide mosaic of sagebrush habitats throughout the west that include:

- Tall sagebrush types such as big sagebrush (*Artemisia tridentata*), three-tip sagebrush (*A. tripartita*), and silver sagebrush (*A. cana*)
- Low sagebrush types, such as low sagebrush (*A. arbuscula*) and lack sagebrush (*A. nova*)
- Mixes of low and tall sagebrush with abundant forbs
- Riparian and wet meadows
- Steppe dominated by native forbs and bunchgrasses,
- Scrub-willow (*Salix* spp.)

- Sagebrush/woodland mixes with juniper (*Juniperus* spp.), ponderosa pine (*Pinus ponderosa*), or quaking aspen (*Popululs tremuloides*)

Call and Maser (1985) summarized characteristics of quality sage-grouse habitat in Oregon as sagebrush steppe between 4,000 and 8,000 feet with annual precipitation of 10 to 16 inches and rolling topography. Within this landscape, sage-grouse need key habitat elements for reproduction and survival. In Oregon, nesting habitat consists of sagebrush plants (*A. tridentata* and *A. arbuscula*) with a strong native herbaceous understory (Hagen et al. 2007).

Sage thrashers were chosen as the surrogate species to represent species, including the sage-grouse, associated with the Shrub-steppe Group in the Woodland/Grass/Shrub Family (Wales et al. 2011). It was felt that sage thrasher represents the full range of habitats and risks associated with this group, including loss, fragmentation, and degradation of sagebrush (*Artemisia* spp.) habitats. Modeling for the sage thrasher indicated that habitat is only moderately departed from historical range of variability, and the influence of open motor vehicle route is low. As a result, there is a moderate level of concern for the viability of the sage thrasher under all alternatives (see Table 333 through Table 335), and therefore the group, for all three national forests.

Habitat for the group represented by the sage thrasher was never highly abundant on National Forest System lands in the Blue Mountains. Species of sagebrush vary by elevation and soils but include low sagebrush, silver sagebrush, rigid sagebrush, basin big sagebrush, Wyoming big sagebrush, mountain big sagebrush, threetip sagebrush, bitterbrush, and rabbitbrush (Johnson and Clausnitzer 1992), all of which make up the sagebrush shrubland habitat. Sage-grouse habitat is a subset of the sagebrush shrubland habitat and as indicated by Hagen (2011) is found on less that 0.7 percent of National Forest System lands in Oregon. The habitat mapping effort for greater sage-grouse in Oregon (Hagen 2011) utilizes the concept of core areas as presented by Doherty et al. (2011) with some modifications, explained in detail by Hagen (2011). For Oregon the core area goal is to identify habitats necessary to conserve 90 percent of Oregon’s greater sage-grouse population with emphasis on the highest density and important use areas which provide for breeding, wintering and connectivity. In addition, low density areas are to be identified that provides breeding, summer and migratory habitats for the statewide population.

In 2012, the U.S. Fish and Wildlife Service created a Conservation Objective Team (COT) of state and U.S. Fish and Wildlife Service representatives to develop conservation objectives for the sage-grouse. The final report (USFWS 2013) identifies key habitats necessary for sage-grouse conservation range-wide and has termed these habitats as priority areas for conservation. These priority areas were developed using maps created by individual states and therefore the priority areas in their report coincide with the core areas identified by Oregon and displayed in Figure 54. The BLM’s National Technical Team identified priority primary habitat (BLM 2011) which is the same as core areas and priority areas for conservation in Oregon. Sage-grouse habitat on the Blue Mountains national forests actually falls into two different management zones (Figure 54), the Snake River Plains and the Northern Great Basin (USFWS 2013). According to the Conservation Objective Team (USFWS 2013), the Malheur National Forest would encompass both management zones and two populations: the central Oregon population, which is considered at risk (C2) or potentially at risk (C3), and the northern great basin population, which is potentially at risk (C3). The Wallowa-Whitman is only in one management zone and encompasses only the Baker population which is considered at risk (C2).

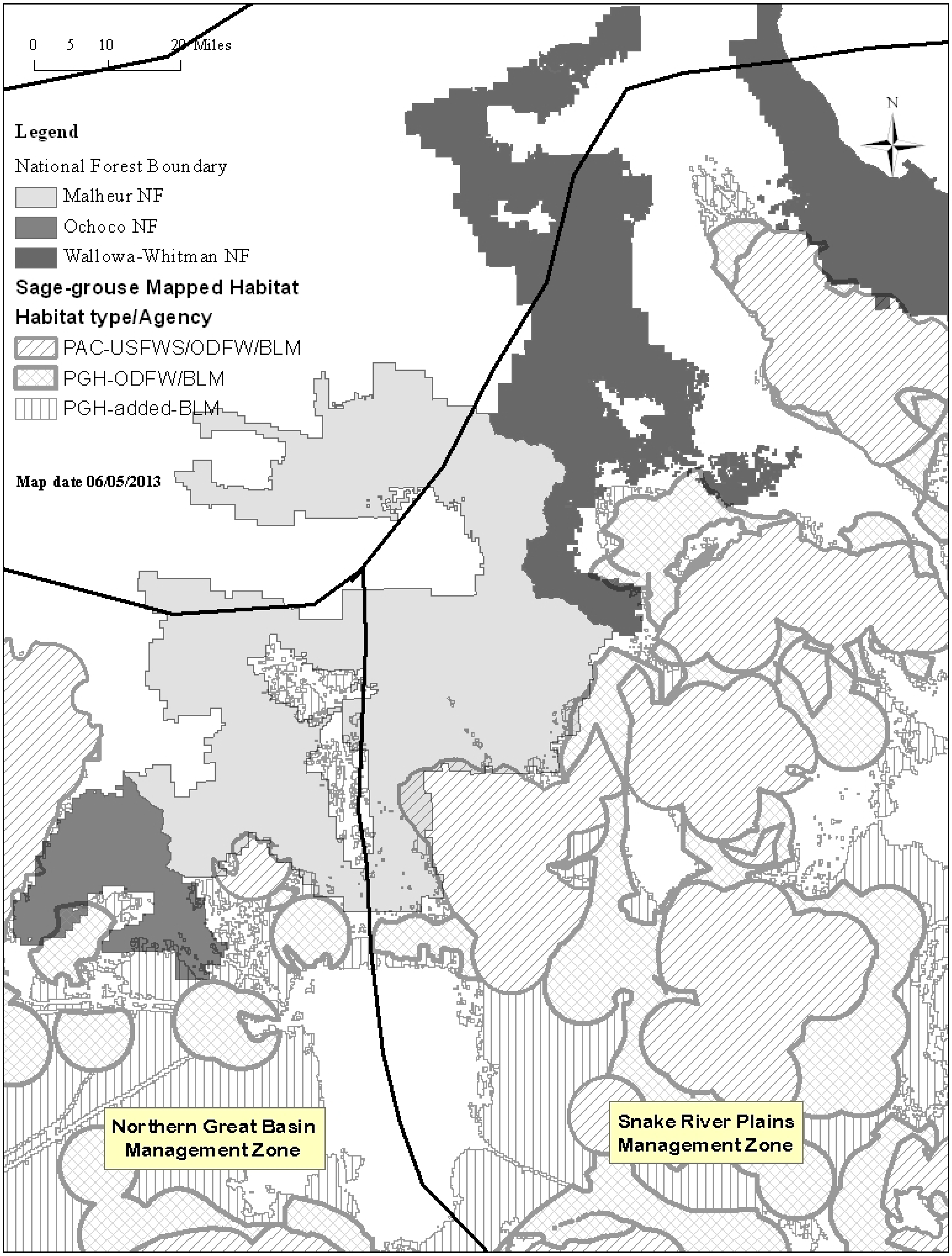

Figure 54. Greater sage-grouse habitat within and adjacent to the Blue Mountains national forests

Effects from Each Alternative on Sage-Grouse

Umatilla National Forest - The greater sage-grouse is not expected to occur within the Umatilla National Forest. Sagebrush habitats were estimated to occur on less than 1 percent of the Forest, none of which was mapped as greater sage-grouse habitat by Hagen (2011). Because the forest is not occupied and there is no known occupied habitat in either Oregon (Hagen 2011) or Washington (Hays et al. 1998) immediately adjacent to the forest, it will not be addressed further.

Malheur National Forest – Sagebrush steppe habitat was estimated to occur on approximately 6 percent of the landscape within the Malheur National Forest; however, not all of this is considered sage-grouse habitat. Habitat mapping completed by Oregon Department of Fish and Wildlife (Figure 54) indicates that only 41,600 acres is considered greater sage-grouse habitat, and of this, 30,000 has been mapped as core habitat, and the remainder as low density habitat. Habitat on National Forest System lands is not contiguous, with the largest block within the Malheur National Forest being slightly more than 24,000 acres of core area habitat (priority area for conservation) occurring in the Snake River Plains Management Zone and associated with the Northern Great Basin population. The Northern Great Basin population is a large population in Oregon, Idaho, Nevada, and Utah. In Oregon, priority areas for conservation and low density (nonpriority but managed) habitat combined capture all but three percent of known summer, one percent of known breeding, and one percent of known wintering habitat. Oregon priority areas for conservation also considered the need to maintain a network of connected habitats. Overall, this part of the population is potentially at risk (C3). Habitat within the Malheur National Forest represents 0.6 percent of sage-grouse habitat in Oregon within this management zone.

The eastern portion of the Malheur is in the Northern Great Basin Management Zone and is associated with the Central Oregon population. This population is estimated to have only 53 percent of historical sagebrush habitat, having lost more historical habitat than any other sage-grouse administrative unit in Oregon. The area also has more privately owned sage-grouse habitat (48 percent) than most other sage-grouse management zone populations in Oregon. Priority areas for conservation and low density (nonpriority but managed) habitat combined capture all but three percent of known summer, one percent of known breeding, and one percent of known wintering habitat. Although a lot of the known habitat is mapped, it is recommended to retain all priority areas for conservation in Central Oregon. Less than 14,000 acres of habitat occur within the Malheur National Forest and less than half of this is considered priority areas for conservation. This represents 0.2 percent of sage-grouse habitat within this management zone in Oregon.

All alternatives include a desired condition to maintain or improve sage-grouse priority habitat management areas and general habitat management areas. In addition, sagebrush steppe is identified as a special habitat for all alternatives (see appendix A 1.13 Special Habitats), with a desire of no net loss and at least 70 percent having an understory of native species, resulting in conditions that are sustainable and resilient to disturbance. In other words they are capable of recovering to their potential community without intervention after a disturbance. The other 30 percent of the landscape would include areas of juniper encroachment, non-sagebrush shrub lands, annual grasslands, and nonnative perennial grasslands that potentially could be rehabilitated and enhanced as sagebrush habitat. This would be true no matter which action alternative is being evaluated.

Management activities likely to occur in sage-grouse source habitats are primarily grazing, invasive plant species control, and fire suppression, all of which are discussed below as threats/risks to habitat. Alternatives E, E-Modified, E-Modified Departure, and F also identify

objectives to reduce juniper encroachment on 800 acres and to reduce sagebrush density on 700 acres in areas where it currently exceeds 25 percent canopy cover during the life of the plan. This represents only a modest gain in habitat, which in all likelihood would not lead to a detectable change in the sage-grouse population.

Threats and Risks

Sage-grouse populations in these two management zones face a wide suite of threats, including juniper encroachment, renewable energy development (both wind and geothermal), energy transmission, roads, off-highway vehicle recreation, mining development, and residential development. Despite efforts to manage wildfire risks, wildfires and invasive species have continued to reduce the quality of habitat in portions of this area (USFWS 2013).

Livestock grazing is the most widespread use of sage-grouse habitats in the west. There is no doubt that historical grazing had significant impacts on sagebrush habitats throughout the west (Crawford et al. 2004) due to season-long use and stocking levels that far exceeded the carrying capacity of the land. Current livestock grazing, however, can be positive, negative or neutral and will vary with timing, intensity of use and a host of environmental factors (Hagen et al. 2011). Grazing may improve brood use of habitat (Dahlgren et al. 2006), reduce nesting success due to loss of vegetation for cover (Beck and Mitchell 2000, Connelly and Braun 1997), or remain neutral by maintaining perennial bunchgrasses with moderate levels of livestock utilization (Stohlgren et al. 1999). Beck and Mitchell (2000) summarized potential effects of livestock grazing on sage-grouse habitats, and cited only four references that provide empirical evidence of direct negative effects of livestock grazing on sage-grouse, as follow: Of 161 nests examined in Utah, two were trampled by livestock (one sheep, one cattle) and five were deserted due to disturbance by livestock (Rasmussen and Griner 1938). As previously discussed for focal species, data for both uplands and riparian areas indicate an improvement in overall rangeland condition under current management. Although recognized that some of the true rangeland sites are strongly or highly departed from their historical condition (see specific information provided in the "Livestock Grazing and Rangeland Vegetation" section), the cause may not be current livestock grazing but rather historical grazing or invasion of nonnative annuals due to fire. Within sage-grouse source habitat, 77 percent of continuous vegetation survey plots were classified as phase C or better; meaning that a large portion of habitat can be restored through proper management. It is assumed that livestock grazing would be managed to achieve the expressed desired conditions of the plan (see Appendix A 1.2 Species Diversity, 1.5 Invasive Species, 1.6 Structural Stages, 1.7 Plant Species Composition, 1.8 Stand Density, and 1.13 Special Habitats), which would result in an improvement of rangeland phases. Alternative C reduces the amount of the national forest considered suitable for livestock grazing by almost 28 percent, eliminating grazing on approximately 400 acres of sage-grouse core habitat and 700 acres of low-density habitat. As previously discussed, stocking rates and utilization levels (residual biomass) have more to do with successful range improvement than anything else. Current forage needs of domestic livestock and wild ungulates is below what has been cited as acceptable use and still see rangeland improvement (Holechek 1988); however, it is also recognized that small areas of overuse can occur. Because of this, alternative C would lead to the most improved sage-grouse habitat, followed by alternatives E, E-Modified, E-Modified Departure, and F, based on exposure to domestic livestock grazing and utilization levels within the uplands (RNG-5 and RNG-6).

Open motor vehicle route density was also identified as a risk factor for the sagebrush group (Wales et al. 2011). Ingelfinger and Anderson (2004) found density of sagebrush obligate birds decreased 39 to 60 percent within a 100-meter buffer of roads with low traffic volumes associated

with natural gas extraction in Wyoming. Although the direct effects of recreational activity on sage-grouse is unknown, there are negative correlations between sage-grouse populations and increased human activity (Connelly et al. 2004). Wales et al. (2011) found road density generally to be low in source habitat for the sagebrush group, which is probably true for sage-grouse habitat as well. Neither road density nor distances to nearest roads were significant factors in the long term persistence of sage-grouse throughout its range (Aldridge et al. 2008); however, negative effects to habitat use and productivity, such as abandonment of leks during the breeding season, may occur locally from proximity of roads (Aldridge and Boyce 2007, Lyon and Anderson 2003). All alternatives include standard WLD-HAB-6 S-1, which prohibits activities that would disturb nesting activity within 1,200 feet of these sites. Alternatives E, E-Modified, E-Modified Departure, and F, however, improve upon this protection measure by restricting open motor vehicle routes within two miles of a lek during the breeding season (WLD-HAB-14). In general, sage-grouse habitats are within MA 4A, which has an open motor vehicle route desired condition of 2.4 miles per square mile or less. It is assumed that motor vehicle travel will be limited to open designated routes with cross-country travel generally not allowed.

Wildfire, both managed and unmanaged, is considered one of the key threats to sage-grouse habitats (Crawford et al. 2004). As with grazing, fire can be positive, negative or neutral in its effects on sage-grouse. The length of the fire cycle has changed, being more frequent in low elevations and less frequent at higher elevations, resulting in invasion of exotic grasses at lower elevations and woodland expansion at higher elevations (Miller et al. 2011). As previously noted, all alternatives would desire plant communities as well as disturbance regimes (i.e., fire) to be within historical range of variability, which should preclude the use of fire as a management tool in the sagebrush community where the risk of exotic grass invasion is high. Alternatives E, E-Modified, E-Modified Departure, and F provide added management emphasis with standards and guidelines (FIRE-4, FIRE-5, and WLD-HAB-22) to call attention to this risk. All alternatives include a desired condition for wildland fire that identifies sage-grouse habitat as a high value resource to be protected from loss due to unwanted fires or damage resulting from management-related activities during wildland fire suppression. Additionally there are standards that address the spread of noxious weeds (NOX-3) and that guide restoration (NOX-2).

Energy development on the landscape has been identified as a significant threat within the range of this species (Doherty et al. 2011). This has mostly been associated with oil and gas exploration, but more recently wind farms have become a concern. Although there is little indication that viable energy sources for development exist within the Plan Area, alternatives E, E-Modified, E-Modified Departure, and F do have plan components (WLD-HAB-15, WLD-HAB-16, and WLD-HAB-17) that would consider habitat adjacent to the national forest as well as within the national forest.

Although the Malheur National Forest constitutes relatively little of the overall sage-grouse habitat in Oregon (0.3 percent) and individual sage-grouse may be impacted, overall management direction of any of the alternatives would contribute to habitat conditions for viability and persistence of this species.

Wallowa-Whitman National Forest – Sagebrush steppe habitat was estimated to occur on less than 1 percent of the landscape for the Wallowa-Whitman National Forest, but according to Oregon Department of Fish and Wildlife (see Figure 54) a little more than 3,000 acres within the Wallowa-Whitman National Forest would be considered sage-grouse habitat, most of which is mapped as core habitat. Habitat within the Wallowa-Whitman occurs in the Snake River Plains Management Zone and represents 0.07 of a percent of the habitat found in this management zone.

Although this management zone supports the largest population of sage-grouse outside of the Wyoming Basin, habitat within the Wallowa-Whitman is only associated with the Baker population, which is thought to have little connectivity with other populations due to habitat and topography. Most (68 percent) of the sage-grouse habitat for the Baker population is in private ownership and 31 percent is administered by the Bureau of Land Management (Hagen 2011). Overall, this population is considered at risk (C2). Most of the area used by this population has been mapped as priority habitat of which less than one percent occurs within the Wallowa-Whitman.

The Baker population is more at risk and probably less resilient as connectivity to other populations appears limited. However, recent telemetry information suggests that at least some birds may move between the Weiser population in Idaho and the Baker population (USFWS 2013). There is no redundancy in this population as everything occurs in one general area. Also, the quality of habitat is more similar to habitat of extirpated populations than extant ones (Wisdom et al. 2011).

As discussed for the Malheur National Forest, all alternatives include a desired condition to restore habitats including the sagebrush steppe. Sagebrush steppe is identified as a special habitat for all alternatives, with a desire of no net loss. Management activities likely to occur in sage-grouse source habitats are primarily grazing, invasive plant species control, and fire suppression, all of which were discussed in detail as threats/risks to habitat for the Malheur National Forest. All of the standards, guidelines discussed for the Malheur National Forest would also apply to the Wallowa-Whitman National Forest. Although less than 0.05 percent of sage-grouse habitat in Oregon occurs within the Wallowa-Whitman National Forest, overall management direction of any of the alternatives would contribute to habitat conditions for viability and persistence of this species even though individual sage-grouse may be impacted.

Wildlife Habitat Connectivity – Affected Environment

Habitats for individual wildlife species normally occur as a mosaic across the landscape. How well a species thrives within this mosaic is closely tied to being able to move across landscapes to find food and other resources, migrate between seasonal habitats, find mates, and shift to new habitats in response to environmental changes. Such movement is dependent on habitat patches being of sufficient size to provide for the life needs of an individual and that other patches occur in a network that allows individuals to successfully move between them. This resource patchiness occurs when a habitat is divided into usable areas that are separated from one another by unusable areas. Within this matrix (habitat and nonhabitat), patches may be connected by corridors (Forman and Godron 1981). Although disagreement exists regarding the utility of corridors, landscape connectivity, which is the degree to which the landscape facilitates or impedes movement among resource patches (Taylor et al. 1993), is important. The recent memorandum of understanding regarding Wildlife Corridors and Crucial Habitats (USDI et al. 2009) signed by the U.S. Department of Agriculture, other Federal agencies, and 19 western states, reinforces the importance of landscape connectivity. This spatial connection of habitats means that either the patches are sufficiently close together so that movement can occur among patches or that there is some corridor along which the organisms can move (Fahrig and Merriam 1985).

In landscape ecology, patches are spatial units at the landscape scale. Patch size can affect species habitat, resource availability, competition, and recolonization. The ability to successfully move between habitats is essential for the long-term survival of many wildlife species, from large, migratory species such as elk (*Cervus elaphus*) and mule deer (*Odocoileus hemionus*), to smaller

animals like white-tailed jackrabbits (*Lepus townsendii*), Greater Sage-Grouse (*Centrocercus urophasianus*), and western toads (*Anaxyrus boreas*). Spatial scale is especially important when dealing with patches because an area large enough to be a patch to one species may be a barrier or be insignificant to another species. For example, a plowed field might be a hunting ground for an owl, a barrier to a deer mouse, and of no consequence to a coyote or deer. Another important aspect of patch size is that larger patches tend to have more linkages than smaller ones (Cantwell and Forman 1993).

Connectivity usually involves corridors and networks that describe how patches are connected in the landscape. A spatial connection means either that the patches are sufficiently close that movement can occur among them, or that there is some corridor along which the organisms can move (Fahrig and Merriam 1985). Many different kinds of corridors can be found in the landscape and they can vary from wide to narrow, meandering to straight, and with high to low connectivity (Forman 1995). Corridor characteristics, such as width, connectivity, curvilinearity, pinch points, etc., control the important conduit and barrier functions of a corridor (Forman and Godron 1981). Riparian zones often function as natural corridors and migration routes for some species, providing a connection between source habitats (Machtans et al. 1996).

Connectivity of habitat patches is dependent upon the species and its ability to disperse. For example, because the pileated woodpecker flies, it would appear that few things would present a barrier to its movements. Bull (1987) documented dispersal of 3.4 kilometers for juveniles based on 8 individuals; however, searches outside of the study area were not conducted. It is probable that at least some of the 20-plus potential survivors of the 87 nestlings banded (using the survival rate given by Bull [2001]) dispersed outside of the study area or more than 16 kilometers. Using Bowman (2003), Samson (2005) calculated a dispersal distance for the pileated of more than 240 kilometers, making most habitats within a national forest available. It is difficult to identify movement patterns across the landscape for large ungulates or forest carnivores without telemetry data showing precise movement patterns. However, in the broad sense, it is possible to assess a landscape and identify areas that could be important travel ways for some species. For example Singleton (Singleton 2002, Singleton et al. 2002) conducted large-scale analysis to identify potential travel corridors between large secures areas (wilderness) for forest carnivores in Washington and Oregon.

Connectivity within forested environments is not only a spatial consideration, but also temporal. In some cases, the movement needs of wildlife can be served with different land cover types than those needed to sustain resident wildlife populations (Washington Wildlife Habitat Connectivity Working Group (WHCWG) 2010). For example, a large clear-cut may pose a movement barrier for American marten immediately post-harvest; however, over time, as it begins to regenerate, although unsuitable habitat, it may have sufficient canopy cover to allow travel between suitable habitat patches. Wales et al. (2011) estimated that the probability for ease of movement through the landscape (high dispersal) within the Plan Area for American marten was less than 22 percent historically (see Table 345). Dispersal or connectivity of habitats was considered an issue for this species, but as demonstrated, a highly permeable landscape probably did not occur historically. A slight decrease from the historical condition to the current condition, with a slight reduction in high and slight increase in the low dispersal probability, has occurred.

Table 345. Percent current and historical dispersal likelihood for the American marten by class for each national forest (Wales et al. 2011)

Time Period	National Forest	Dispersal Classes and Likelihood		
		Low	Moderate	High
Current	Malheur	25	70	5
	Umatilla	24	52	23
	Wallowa-Whitman	40	44	16
Historical	Malheur	18	71	11
	Umatilla	22	48	31
	Wallowa-Whitman	37	38	25

Maintaining linkages and connectivity may not always be beneficial. Simberloff and Cox (1987), Simberloff et al. (1992), and Hess (1994) argued that corridors might enhance the spread of disease, catastrophic disturbances, such as wildfires, or the spread of exotic species into the areas connected by corridors. Corridors might also lure animals into areas, including the corridors themselves, where they experience higher mortality [for a review see Hobbs (1992)]. Samson (2005) notes:

> …increases in intermediate-aged forests and connectivity threaten key remaining elements of biodiversity, such as areas of old growth, as these areas no longer persist in fire-protected refugia but are embedded in a well-connected matrix of intermediate-aged forest that permits the rapid spread of fire and insect outbreaks with a spatial-temporal pattern unlike the historic landscape.

Washington recently completed a statewide connectivity analysis (Washington Wildlife Habitat Connectivity Working Group [WHCWG] 2010) which incorporated a large portion of the Blue Mountains in Oregon and Idaho as well. The products produced were derived from two modeling approaches: 1) A focal species approach, which produced linkage networks for 16 representative species, and 2) a landscape integrity approach, which produced networks of lands exhibiting high degrees of landscape integrity and relatively intact natural areas with low levels of human modification. Linkage network was defined as a system of habitats and areas important for connecting them. Composite linkage networks for groups of focal species resulted in three “connectivity guilds”: (1) generalist, (2) montane, and (3) shrubsteppe. The networks for the generalist and montane species guilds are generally broadly connected, with the interruptions fitting the traditional view of “fracture zones”, i.e., linear features that pose significant barriers to animal movement. The Washington Working Group (2010) also found broad consistency between the linkage patterns identified by the focal species and the landscape integrity approaches. The landscape integrity approach mirrors the approach used in the California Essential Habitat Connectivity Project (Spencer et al. 2010) in that it is not tailored to specific species or habitats. It is indifferent to vegetation type—apart from degree of departure from natural conditions—and is intended to provide a coarse filter for species and processes that are sensitive to human disturbance.

Figure 19 illustrates that forested areas of the Blue Mountains are reasonably well connected for most of the focal species used within the generalist category (western toad, mule deer, elk, bighorn sheep, western gray squirrel), and no use areas are a result of human development such as agricultural lands and highways. As mentioned above, this was the case for the montane guild as well. It should also be noted that even though five species are indicated for the generalist group and the maximum for the Blue Mountains is four, the fifth focal species (western gray squirrel)

modeled for Washington does not occur in the Blue Mountains. Therefore, a linkage network for four species in the Blue Mountains would be the maximum that could occur.

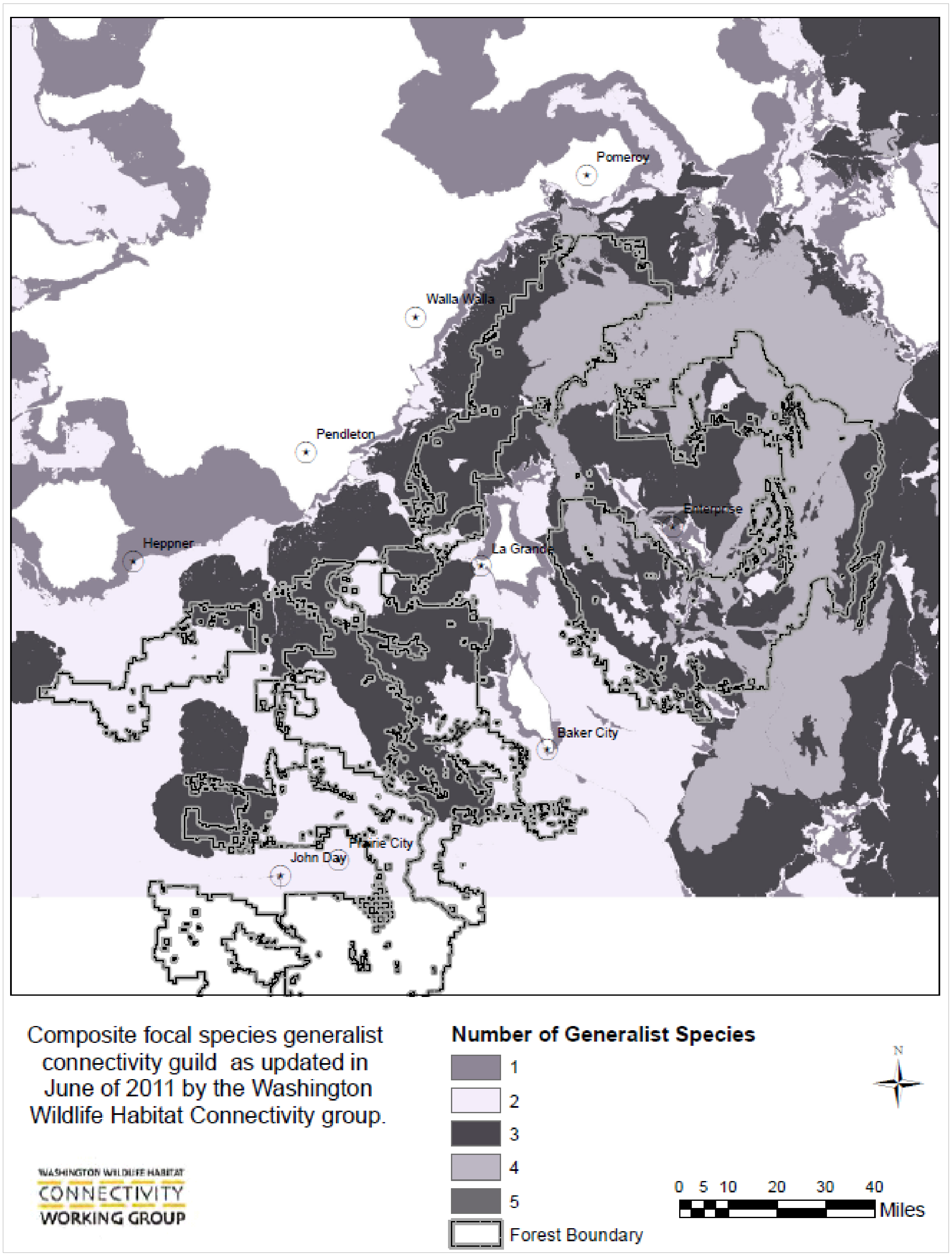

Figure 19. Composite focal species and landscape integrity map for generalist connectivity guild; Includes species that can inhabit a variety of habitats such as mule deer and western toads[11]

[11] developed from data available at http://waconnected.org/statewide-analysis

Wildlife Habitat Connectivity – Environmental Consequences

The Washington analysis identified four overarching types of threats/barriers and their potential effects on species' movements:

1) **Land clearing/vegetation removal**, which limits connectivity through

- Alienation due to lack of security cover
- Change to inhospitable environment (e.g., desiccating conditions for amphibians)
- Alienation due to lack of forage or prey
- Increases in competing species, predators, invasive exotics

2) **Buildings and infrastructure**, which limit connectivity through

- Barriers to movement created by fences, walls, buildings, asphalt, canals, etc.
- Alienation due to noise, lighting, lack of forage or prey
- Increases in competing species, predators, invasive exotics
- Making important habitat areas inaccessible (e.g., streams diverted into culverts)

3) **Roads and traffic**, which limit connectivity through

- Creation of inhospitable conditions (e.g., desiccating conditions for amphibians)
- Creation of physical barriers (e.g., Jersey or Texas barriers, right-of-way fences)
- "Fatal attraction" (e.g., attraction of snakes to warm road surface)
- Increased mortalities due to collisions
- Behavioral alienation (i.e., avoidance of roads or high traffic volumes)

4) **Presence of people or domestic animals**, which limit connectivity through

- Legal harvest and poaching
- Harassment and disturbance
- Disease transmission (e.g., domestic sheep to bighorn sheep)
- Intolerance (e.g., conflict resolution removals)

Many of these threats are not anticipated to occur on National Forest System lands, but could and do occur adjacent to them and will be discussed as cumulative effects. In general, the two greatest potential barriers on the national forest are roads and presence of people. As mentioned, alteration of vegetation can cause short-term disruptions in travel ways used by a species such as American martens, but in general do not result in long term isolation of habitat patches. This is evidenced by the landscape integrity (areas that have low levels of human modification and are in a relatively natural condition) modeling that the Washington Working Group conducted (WHCWG) 2010). Their assessment of the marten also showed that habitat in the Blue Mountains is largely surrounded by impermeable conditions; both natural (low-elevation forests, grasslands, and shrublands) and human created features (highways, dams, towns, and railways), suggesting this population will remain isolated from all others. They further found that habitats in the Blue Mountains of southeastern Washington and northeastern Oregon showed some linkages, but are largely isolated from each other.

All alternatives, including Alternative A (no action), provide some degree of secure areas and connectivity. Both the Wallowa-Whitman and the Umatilla National Forests have more than 30 percent of National Forest System lands in areas with minimal human disturbance in all

alternatives except Alternative A. The Malheur National Forest only accomplishes this for Alternative C.

Short-term disruption of connectivity between habitat patches for some species can occur due to vegetation treatments. The greatest potential for disruption of wildlife movement patterns occurs for Alternatives D, E, E-Modified and especially E-Modified Departure because of the level of mechanical vegetation treatments. Alternative C would be the least disruptive, but in all cases a very low percentage of the landscape is being treated for all alternatives. Alternatives A and C include safeguards addressing connectivity (WLD-HAB-4 and Eastside Screens amendment), which, combined with desired conditions, would provide the greatest connectivity between habitat patches.

Connected landscapes are especially important for wide-ranging species, such as carnivores (Beier 1993), and for migratory species, such as large herbivores and migratory birds (Bennett [1999, 2003]). They can be critical for maintaining genetically healthy populations, because immigration helps small populations avoid inbreeding (Hanski and Gilpin 1997). As demonstrated by the above analysis, connectedness of habitats is a complex issue. Taking into consideration all of the variables presented above, Alternative C appears to provide the greatest opportunity to maintain or improve connectedness of habitats. The establishment of MA 3C provides corridors connecting large secure wildlife areas within which habitat linkages can be designed. Establishing such corridors allows for the design of ecological connections (habitat linkages) that may take a variety of forms, not just simple linear connecting patches of habitat.

Alternative A would probably be the second best at providing for connectivity. Although more treatment would occur for this alternative within the Wallowa-Whitman National Forest in the dry forest compared to some of the other plan revision alternatives, the standards and guidelines from the Eastside Screens amendment are somewhat more restrictive than the standards and guidelines for other plan revision alternatives. It is unknown how the other plan revision alternatives compare to one another because it is not a direct relationship between acres of treatment and connectivity. Connectivity will depend largely on the exact locations and intensity of harvest, which will be determined during project level planning.

Riparian zones function as natural corridors and migration routes for some species, providing a connection between source habitats (Machtans et al. 1996). Each of the alternatives establishes some degree of special designation for areas to be managed as riparian areas. The intent of these areas was the recovery of the riparian zone, but at the same time, this recovery can lead to providing travel corridors for terrestrial wildlife between source habitat patches. Alternative A, as amended by PACFISH/INFISH, has riparian management designations that vary in width from 300 feet to 50 feet depending upon the stream. Alternatives B, E, E-Modified, E-Modified Departure, and F have riparian widths that vary from 300 feet to 100 feet. Alternative C has a riparian width of 300 feet for all situations, whereas Alternative D varies from 100 feet to 50 feet. Alternative C provides the greatest opportunity for riparian areas to act as connectors between habitat patches on all three National Forests, whereas Alternative D actually provides less connectivity than what is provided by the 1990 Forest Plans as amended.

Cumulative Effects to Wildlife Habitat Connectivity

Some of the cumulative effects suggested above have already been discussed in other sections of this document (e.g., the potential of spreading disease to bighorn sheep from privately grazed lands). Additionally, the continued subdivision of larger parcels to smaller parcels continues to be

occurring on land adjacent to and between portions of public lands, which restricts wildlife movements due to increases in fencing and other infrastructure. The continued improvement of county, state and federal roads increases the barrier effect to wildlife, isolating some habitat patches from others for certain species.

In addition to these considerations, climate change may force new patterns of wildlife movements in response to changing environmental conditions and shifting habitats (Heller and Zavaleta 2009).

Cumulative Effects to Terrestrial Wildlife Species (Basinwide Scale)

In general, the analysis area for cumulative effects is all those lands within the Blue Mountains Ecoregion, including Bureau of Land Management, State and private lands as well as those lands within the Columbia Plateau Ecoregion. However, cumulative effects will vary depending on the individual needs and habitat of individual species, and impacts from resource use outside forest boundaries. Cumulative effects to wildlife are also based on the cumulative effects described for vegetation, watersheds, and aquatic resources in their respective sections in this chapter.

The lack of younger seral conditions was identified as a concern from a diversity of habitat standpoint. Management directed at striving for the historic range of variability would provide improved habitat for many species. Because private forest lands have been managed more intensively, it is highly likely that some of these early seral conditions are being provided on those lands. As demonstrated in the effects analysis, the proposed level of activity under any alternative will not be enough to bring the dry forest within the historical range of variability over the next several decades. The departure is so large that our goal can only be to produce an upward trend, and although the younger seral stages may occur on lands outside of the forest, it is extremely unlikely that the old forest structure, which is also highly departed, will be produced outside of national forest lands.

Regional risk trends for some species date from the westward expansion and settlement. For example, the greater sage-grouse has seen its habitat shrink largely due to habitat losses that have occurred outside of national forest lands. The bulk of habitat currently occurs on Bureau of Land Management lands. Little habitat occurs on the national forests, with all known breeding sites and the vast majority of nesting habitat occurring outside the forests. As such, long-term viability of this species in Oregon is fundamentally beyond the scope of the national forest management to affect.

Fire suppression on neighboring Federal, State and private lands are routinely coordinated. Given the likelihood of increasing populations in surrounding communities, fire management is expected to be increasingly influenced by public concerns about threats to investments, air quality, and aesthetics. The extent of this influence will be driven by public perceptions and will be variable and not quantifiable. There is a possibility that wildland fire use for resource management on the national forests could be hampered by adverse public perceptions to fires allowed to burn under a wildland prescription

Growing demand for motorized recreation, snowmobiling in particular, includes all ownerships adjacent to the forest. “User built” trails are made by off-highway vehicle users, expanding their play areas. Conflicts, such as trespass into areas closed to motorized use, are likely to arise as snowmobile and off-highway vehicle ownership increases. Increased use of National Forests is also expected to facilitate expansion of noxious weeds and other undesirable or nonnative vegetation species. Urban expansion, both locally and regionally, reduces the ability of non-

federal land to function as biological reserves and provide wildlife habitat connectivity at broad scales.

Wildlife species do not recognize political or administrative boundaries. Effective wildlife management involves local, regional, state and Federal agencies; public land users; industry; and private landowners. Oregon and Washington completed statewide conservation strategies in 2006 and 2005, respectively. These documents, developed in collaboration with the diverse groups mentioned above, provide the baseline information on the status, distribution, risks and management considerations for species and habitats of greatest concerns for the two states. In addition to these assessments, findings in local subbasin assessments, Partners in Flight products, state fish and wildlife products, and the Interior Columbia Basin Ecosystem Management Project (ICBEMP) have been reviewed for baseline information and additive actions that affect the landscape scale efforts of conservation and restoration.

The Interior Columbia Basin Project conducted a large-scale viability assessment within the Columbia basin in the late 1990s. Although datasets, analysis area (all lands versus National Forest System lands) and methodology differ slightly, the results (see Table 346) are instructive. In some cases, like the white-headed woodpecker, there is strong agreement between the results from this analysis and that of the Interior Columbia Basin Project. In other cases, such as the black-backed woodpecker, the trend would be considered increasing rather than decreasing, at least on the National Forests.

Table 346. The relative change in habitat and trend category for the Blue Mountains Ecological Reporting Unit from ICBEMP (Wisdom et al. 2000)

Species	Season	Group	Change	Trend
Boreal owl	Year round	7	-3.25	Stable
Northern goshawk	Summer	5	-29.33	Decreasing
Northern goshawk	Winter	25	-24.71	Decreasing
American marten	Year round	5	> 100	Strongly increasing
Pileated woodpecker	Year round	6	> 100	Strongly increasing
White-headed woodpecker	Year round	1	-79.26	Strongly decreasing
Western bluebird	Year round	29	-64.24	Decreasing
Black-backed woodpecker	Year round	9	-30.96	Decreasing
Lewis's woodpecker	Year round	2	-72.17	Strongly decreasing
Wolverine	Year round	15	> 100	Strongly increasing
Lark sparrow	Year round	31	-46.28	Decreasing
Ash-throated flycatcher	Year round	30	> 100	Strongly increasing
Sage thrasher	Year round	33	-28.28	Decreasing
Gray-crowned rosy finch	Year round	38	0	Stable
Fringed myotis	Year round	26	14.12	Stable
Pallid bat	Year round	28	-41.98	Decreasing
Loggerhead shrike	Year round	35	-9.64	Stable
Rocky Mountain bighorn sheep	Summer	22	-47.61	Decreasing
Rocky Mountain bighorn sheep	Winter	22	-53.6	Decreasing
Townsend's big-eared bat	Year round	27	10.42	Stable

Many of the species that are addressed within this document have home ranges or territories that would be expected to extend beyond the boundaries of National Forest System lands. For some species, such as neo-tropical migratory birds, impacts from far-distant areas may have much greater effects than forest management activities. An example is the severe mortality in Swainson's hawks from pesticide poisoning on wintering areas in Argentina (Goldstein et al. 1999). The upland sandpiper is considered a long-distant migrant, spending the breeding season in the United States, but wintering in South America. Other species such as mule deer may summer on National Forest System lands, but winter in valley bottoms and agricultural lands. As such, species are potentially exposed to local area effects, such as the continued alteration of riparian habitats on lands of other ownership. At the same time, local governments have been encouraging riparian habitat improvement projects on private lands that will actually be a beneficial cumulative effect. Other habitats that occur mostly on other ownerships, such as the sagebrush-steppe, will probably continue to be lost to invasive species like cheatgrass as management practices on private land, and the continued transportation corridors and resulting connectivity with un-invaded habitats, allow the spread of invasive species.

Wildlife and Climate Change

All organisms depend on their habitats for food, water, shelter, and opportunities to breed and raise young. Climate changes can affect organisms and their habitats in many ways. In fact, climate change likely impacts all life on Earth, from individual organisms to populations, species, communities, and ecosystems. It may alter behavior, population size, species distributions, plant and animal communities, and ecosystem function and stability. How strongly different species will be affected differs, depending on differences in their ecology and life history. Species with small population sizes, restricted ranges, specialized habitat requirements and limited ability to move to different habitat will be most at risk. Similarly, different habitats and ecosystems will be impacted differently, with those in coastal, high-latitude, and high-altitude regions most vulnerable.

According to Hayes (2011), the accelerating change in climate poses the single biggest threat to wildlife species in the United States. Climate change likely will lead to the loss of native species from extensive areas and result in increasingly scarce and fragmented populations in many others. Further changes within ecosystems will be triggered as invasive species, both plant and animal, fill voids that are left as native species are lost. Associated changes in the food web will cascade and further destabilize ecosystems. Climate change effects will vary by ecosystem, and, although there have been many articles published on potential climate change effects on wildlife; a large degree of uncertainty still exists.

Terrestrial Species (Ruggiero et al. 2008)

Wildlife species, such as the wolverine (*Gulo gulo*), snowshoe hare (*Lepus americanus*), and short-tailed weasel (*Mustela erminea*), have adapted to snowy environments. The snowshoe hare, for example, is well adapted to deep snow based on its large snowshoe-like feet. A warming climate will put this species at a disadvantage, and, importantly, this species is a food source for many predators. Specific tight relationships between predators and their prey (e.g., American marten and red squirrel (*Tamiasciurus hudsonicus*)) may break apart as each species responds differently to climate changes. Native species may be further stressed by the proliferation of invasive species that thrive in warmer conditions.

Climate projections for late century (after 2050) suggest a high probability for the loss of alpine and sub-alpine ecosystems. These cold-adapted ecosystems, such as whitebark pine forests and alpine meadows, will become smaller and will eventually disappear as they are pushed up the mountains. Populations of fauna associated with these ecosystems will become increasingly fragmented and prone to extinction. Habitat isolation and restricted species movement will become prevalent. For example, breeding populations of gray-crowned rosy finches may become isolated on lingering high-elevation, boreal islands, threatening the long-term viability of the species.

Increases in disturbance owing to fire, and insects and diseases will accelerate the infiltration of weeds. This is of particular concern in the Blue Mountains, where fire frequency and severity are expected to increase as the climate warms. The loss of native ecosystems to weeds affects many species of terrestrial fauna. Many animal species could be extirpated from the Blue Mountains as changes in vegetation patterns ripple through the ecosystems.

Amphibians and Reptiles (Synthesized from Lind 2008)

For amphibians and reptiles, responses to climate change will be influenced by the following primary factors: (1) expected changes and variability in local environmental and habitat conditions, (2) the phenology (timing) of life-requisite activities, (3) interactions with emerging pathogens and invasive species, and (4) interactions with other environmental stressors (e.g., chemicals). For example, in Oregon, frogs are breeding earlier in the spring and the incidence of infectious diseases among them is increasing (Oregon Climate Change Research Institute (OCCRI) 2010). Changes in wet periods, snowpack, and flooding frequency will determine reproductive success rates and survival to metamorphosis (OCCRI 2010). Over the long term, the frequency and duration of extreme temperature and precipitation events will likely influence the persistence of local populations, dispersal capabilities and consequently the structure of metapopulations on the landscape. Synergisms among a variety of environmental stressors adversely affect native amphibians and reptiles and climatic changes are likely to exacerbate these effects.

Although amphibians and reptiles are typically grouped together in assessments such as this one, it should be noted that these two groups represent a great variety of species that are adapted to diverse ecosystems and environments throughout the world. In general, particular ecological communities are expected to move upward in both elevation and latitude (Walther et al. 2002). As with other species, montane and higher-latitude populations of amphibians and reptiles are most at risk (Root et al. 2003). Amphibians have recently been experiencing global population declines (Stuart et al. 2004) and similar signs of decline may be emerging for reptiles (Gibbon et al. 2000).

Amphibian and reptile populations are sensitive to and respond strongly to changes and variability in air and water temperature, precipitation, and the hydroperiod (length of time and seasonality of water presence) of their environments (Carey and Alexander 2003). Many amphibians require aquatic habitats for egg laying and larval development, and moist environments for post metamorphic life stages. As temperatures warm and the availability of aquatic habitats become more variable, amphibians are likely to experience lower rates of survival. Species associated with ephemeral waters, such as shallow ponds and intermittent streams, may be particularly vulnerable to altered precipitation patterns. Some reptile species exhibit temperature-dependent sex determination during egg incubation that could be influenced by changes and variability in global climates (Gibbon et al. 2000, Hawkes et al. 2007). Increases

in frequency or intensity of wildfires could create changes that may directly affect animals during the wildfire event or degrade habitat conditions necessary for their survival post wildfire.

Amphibians typically have relatively small home ranges and low dispersal rates, although there are some exceptions. Reptiles are somewhat more mobile and have a greater ability to withstand the expected dryer and warmer conditions. However, in areas where key habitats and species ranges have already been altered and fragmented by human use and development, the physical pathways to connect animals with suitable habitats (e.g., upwards in latitude or elevation) may not exist. Although some near-term benefits of climate warming may be seen for some reptile species owing to increases in preferred temperatures and activity periods (Chamaille-Jammes et al. 2006), over the long term, expected variability and temperature extremes will likely not be beneficial to these taxa.

For amphibians and reptiles, the timing of key ecological events is influenced by environmental conditions, such as air and water temperature and precipitation patterns. Lawler et al. (2009) found amphibian ranges were thus more vulnerable to changes in precipitation than were those of birds or mammals. The timing of reproduction (breeding/egg laying), metamorphosis, dispersal, and migration may shift in response to higher temperatures and changes in rainfall (Beebee 1995). If such shifts in amphibian and reptile activities occur inconsistently with other ecological events (e.g., emergence of their insect prey), growth and survival rates would be affected.

Recent research on amphibian declines has documented the role of emerging pathogens and in some cases epidemic outbreaks of particular infections and diseases (Daszak et al. 2003). Changes in climatic regimes are likely to increase pathogen virulence and amphibian and reptile susceptibility to pathogens. Similarly, warm water invasive species (e.g., bullfrogs and some fishes in the western United States) are a concern to native species and may expand their ranges given warming trends, particularly earlier warming in the spring (Bury and Whelan 1984).

Birds

In North America, the northern limits of many bird species are strongly associated with various climatic variables (e.g., winter temperature). Both the ranges and the abundances of birds shift on an annual basis in concert with temperature. Studies have shown that a significant number of migrating birds are arriving up to three weeks earlier now than they did in 1960. Apparently, many bird species can and do respond to changing climatic conditions. Because their ranges are limited by vegetation, these birds probably will not be able to shift their ranges with the changing climate, at least not until the vegetation itself shifts. Consequently, natural communities of birds may change dramatically as changes in climate and vegetation favor some species and harm others. It is difficult to predict how these changes will influence community structure or function.

The pattern in Oregon is consistent with this assessment. Ranges of some birds are moving north and increasing in elevation. The other major change is the probable shift to an earlier breeding season as the temperatures become warmer earlier in the spring. Birds associated with higher elevation wetlands dependent on snowpack may be adversely affected (North American Bird Conservation Initiative (NABCI) 2010). Some forest birds already of concern may be affected by summer drying. Birds in the transition zone to the Great Basin, along the southern edge of the Blue Mountains, will be particularly vulnerable to summer drying (Olson and Burnett 2009).

Bird populations will be affected by a set of cumulative effects, including changes in ranges and migratory patterns. Earlier spring warming will affect breeding, as will changes in abundance of insects. Insects are particularly affected by climate dynamics, since their development is closely

tied to temperature. For example, an increase in temperature of 2 degrees Celsius will change the availability of insects as a food source by more than 18 days (OCCRI 2010). Birds migrating may thus be adversely affected by asynchrony; they could arrive at a time when the level of insects they feed their young has declined, passed, or not yet occurred. Jones and Cresswell (2009) state:

> The phenology mismatch hypothesis predicts that migrant birds, which experience a greater rate of warming in their breeding grounds compared to their wintering grounds, are more likely to be in decline, because their migration will occur later and they may then miss the early stages of the breeding season. Population trends will also be negatively correlated with distance, because the chances of phenology mismatch increase with number of staging sites.

Because of this complicated set of trends, it is difficult to predict specific outcomes with confidence. Nevertheless, management actions to foster relatively intact and functioning ecosystems will be the best strategy to mitigate these effects.

Plant Species Diversity and Threatened, Endangered, and Sensitive Plants

Changes Made Between the Draft and Final Environmental Impact Statements

Aside from the global changes throughout this environmental impact statement described in the Preface to this document (see Volume 1), the following changes were made specifically to this section:

- Effects discussion were expanded or clarified to respond to comments on the Draft Environmental Impact Statement.
- Tables displaying sensitive species by habitat groups were updated to reflect the 2011 Regional Forester’s sensitive species list.

Methodology

Throughout this analysis, plan components, such as standards and guidelines are referend to by their label, for example, FLS-2G or FLS-3S. “FLS” refers to “federally listed and sensitive”; “G” represents “guideline” and “S” represents “standard.” Please refer to Appendix A in Volume 4 for full descriptions of plan components under each alternative. For all plan revision alternatives (B-F) plan components for federally listed and sensitive plants are found mainly under the heading 1.3 Federally Listed Species. Some plan components that apply to sensitive species are found under the heading 1.2 Species Diversity.

Threatened and endangered plant species are designated by the U.S. Fish and Wildlife Service and published in the Federal Register. There are two federally threatened plant species: MacFarlane’s four-o’clock (*Mirabilis macfarlanei*) and Spalding’s catchfly (*Silene spaldingii*). These two species are evaluated separately, with the results of the analysis reported here. Sensitive plant species are designated by the regional forester. The 2011 Regional Forester's Special Status Species List (USDA Forest Service 2011c) was used to identify the sensitive plant species present on the Malheur, Umatilla and Wallowa-Whitman National Forests.

To facilitate analysis, sensitive plant species are grouped into habitats following the approach used in the Analysis of Vascular Plants for the Interior Columbia Basin Ecosystem Management

Project (Croft et al. 1997). This analysis identified six broad habitat types: alpine, aquatic/riparian, forests, grasslands, rock, and shrublands, which were further subdivided into habitat subgroups based on specific cover types or elevation zones. For this analysis, sensitive plant species were assigned to one of the six broad habitat types, and then further subdivided if more distinct habitat groups were necessary to analyze forest plan components. This resulted in identifying 14 habitat groups. Table 347 displays these habitat groups and their corresponding broad habitat type from the Interior Columbia Basin Ecosystem Management Project Analysis of Vascular Plants (Croft et al. 1997).

Table 347. Habitat group for the sensitive plant species analysis

Blue Mountains Forest Plan Revision Group	ICBEMP Vascular Plant Habitat Type
Alpine fellfields and subalpine parkland	Alpine
Conifer forest	Forests
Aspen, Cottonwood	Forests
Sagebrush shrubland	Shrublands
Basalt lithosol	Shrublands
Grassland	Grasslands
Talus, Cliffs and rock outcrops	Rock
Aquatic	aquatic/riparian
Fen	aquatic/riparian
Seep/spring	aquatic/riparian
Riparian	aquatic/riparian
Intermittent stream	aquatic/riparian
Moist meadow	aquatic/riparian
Wet meadow	aquatic/riparian

ICBEMP = Interior Columbia Basin Ecosystem Management Project

Two underlying assumptions are central to the plant assessment process (Holmes, et al. 2009):

1. Diversity objectives will be achieved for all native plant species through ecosystem diversity plan components except for federally listed species and Forest Service sensitive species. Species other than federally listed species and Forest Service sensitive species have NatureServe global and state ranks, which indicate that they are secure or they are demonstrably widespread and abundant.
2. A diversity outcome for any grouping of Pacific Northwest Region sensitive species via stratification on specialized habitats reflects the diversity outcome for each species in that group.

For each habitat group, forest plan components (goals, standards, guidelines and objectives), by alternative, are evaluated for their predicted ability to meet the direction set forth in Sections 219.26 and 219.27 of the 1982 planning rule and in their ability to achieve the desired conditions for federally listed plants and Forest Service Pacific Northwest Region sensitive plants.

For sensitive plants, one of the following effects determinations are made for species in each of the habitat groups (Salwasser et al. 1995):

- **No impact -** a project or activity will have no environmental effects on habitat, individuals, a population or a species.

- **May impact individuals or habitat, but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species -** activities or actions that have effects that are immeasurable, minor or are consistent with conservation strategies would receive this conclusion.
- **Will impact individuals or habitat with a consequence that the action may contribute to a trend towards federal listing or cause a loss of viability to the population or species -** Loss of individuals or habitat can be considered significant when the potential effect may (1) contribute to a trend toward federal listing (C-1 or C-2 species); (2) result in a significantly increased risk of loss of viability to a species; or, 3) result in a significantly increased risk of loss of viability to a significant population (stock).
- **Beneficial impact -** Projects or activities that are designed to benefit, or that measurably benefit a sensitive species should receive this conclusion.

Proposed forest plan goals, desired conditions, and standards and guidelines common to all plan revision alternatives are found in appendix A. Alternative A, the no-action alternative, is the continuation of the 1990 Forest Plans for the Malheur, Umatilla, Wallowa-Whitman, and Ochoco National Forests (the portion of the Ochoco National Forest administered by the Malheur National Forest's Emigrant Creek Ranger District). These plans include management direction to provide a diversity of habitat sufficient to maintain viable populations of plant and animal species.

Threatened and Endangered Plants

Threatened, endangered, and proposed plant species are designated under the Endangered Species Act by the U.S. Fish and Wildlife Service (USFWS). One threatened species, Spalding's catchfly (*Silene spaldingii*), is present within the forest plan revision area. A second threatened plant, MacFarlane's four o'clock (*Mirabilis macfarlanei*) is not present, but suitable habitat for the species may exist within the Plan Area.

Spalding's Catchfly – Affected Environment

Spalding's catchfly was listed as a threatened species under the Endangered Species Act October 10, 2001. Spalding's catchfly is an herbaceous perennial in the pink family (Caryophyllaceae). Seasonal stems emerge in the spring from the root crown, sending usually one, but occasionally a second shoot 8 to 24 inches in height. Each stem has typically 4 to 7 pairs of leaves and 3 to 20 flowers on reproductive shoots. Dense, sticky hairs that cover the stems, leaves, and the floral calyx entrap small insects, hence "catch-fly." The species has a long taproot that can exceed 1 meter (39 inches). Spalding's catchfly begins blooming in mid to late July. Blooming continues through August and sometimes into September. Fruits mature from August until September. The small, 2-mm, seeds are wrinkled, winged and dispersed by wind following dehiscence of the capsule (USFWS 2007).

Spalding's catchfly is endemic to the Palouse region of southeastern Washington and adjacent Oregon and Idaho, and is disjunct in northwestern Montana and British Columbia, Canada. Spalding's catchfly inhabits predominantly the Pacific Northwest bunchgrass grasslands and sagebrush-steppe and occasionally in open-canopy pine stands. Populations inhabit five physiographic regions: (1) the Palouse Grasslands in west-central Idaho and southeastern Washington, (2) the Channeled Scablands in east-central Washington, (3) the Blue Mountains Basins in northeastern Oregon, (4) the Canyon Grasslands along major river systems in Idaho, Oregon, and Washington, and (5) the Intermontane Valleys of northwestern Montana and British

Columbia, Canada. The Plan Area includes Spalding's catchfly occurrences in Blue Mountains Basins and Canyon Grasslands physiographic regions.

The recovery plan for Spalding's catchfly (recovery plan) outlines a strategy to protect and maintain reproducing, self-sustaining populations in each of the five physiographic regions where the plant grows to ensure the long-term persistence of the species (USFWS 2007). Within each of these regions, the U.S. Fish and Wildlife Service, with the assistance of an interagency technical team, identifies key conservation areas to focus conservation efforts on the larger populations that support at least 500 plants. Until the U.S. Fish and Wildlife Service completes a comprehensive population viability analysis, the recovery plan assumes 500 individuals to be the minimum viable population size. A key conservation area possesses the following qualities:

- Is composed of intact habitat (not fragmented), preferably 40 acres or greater
- Native plants comprise at least 80 percent of the canopy cover of the vegetation
- Adjacent habitat is sufficient to support pollinating insects
- Habitat is of the quality and quantity necessary to support at least 500 reproducing individuals of Spalding's catchfly

According to the recovery plan, key conservation areas should be surrounded, where possible, by 300 acres of habitat that is intact or could be restored to support Spalding's catchfly.

The plan area includes three Spalding's catchfly key conservation areas: two inhabit the Wallowa-Whitman National Forest in the Blue Mountains Basins physiographic region and one inhabits the Umatilla National Forest in the Canyon grasslands physiographic region (Table 348). In the Blue Mountains Basins physiographic region, two additional key conservation areas lie outside the Plan Area on state and private lands. The vast majority of Spalding's catchfly inhabiting the Blue Mountains Basins physiographic region grows on the Zumwalt Prairie key conservation area owned and managed by the Nature Conservancy. Likewise, most of the Spalding's catchy inhabiting the Canyon Grasslands physiographic region is located outside the plan area on four additional key conservation areas. The Forest Service manages a minority of the Spalding's catchfly inhabiting the Blue Mountains and surrounding Canyon Grasslands.

Across its range, the main threats facing Spalding's catchfly are habitat loss due to development, habitat degradation associated with adverse grazing and trampling by domestic livestock and wildlife, and invasions of aggressive, nonnative plants (USFWS 2007). In addition, a loss of genetic fitness is a problem for small, fragmented populations where genetic exchange is limited. Other impacts include changes in fire frequency and seasonality, off-road vehicle use, and herbicide spraying and drift. On National Forest System lands, the main threats to Spalding's catchfly are invasions by aggressive, nonnative plants, adverse livestock grazing management, and changes in fire frequency and seasonality.

Table 348. Spalding's catchfly key conservation areas in the Blue Mountains Basins and Canyon Grasslands physiographic regions

Physiographic Region	Key Conservation Area	Plan Area
Blue Mountains Basins	Clear Lake Ridge	Wallowa-Whitman National Forest and other ownership
Blue Mountains Basins	Crow Creek	Wallowa-Whitman National Forest and other ownership
Blue Mountains Basins	Wallowa Lake	Not in Blue Mountains Revised Forest Plans Area
Blue Mountains Basins	Zumwalt Prairie	Not in Blue Mountains Revised Forest Plans Area
Canyon Grasslands	Blue Mountains Foothills	Umatilla National Forest and other ownership
Canyon Grasslands	Craig Mountain	Not in Blue Mountains Revised Forest Plans Area
Canyon Grasslands	Garden Creek	Not in Blue Mountains Revised Forest Plans Area
Canyon Grasslands	Joseph Creek	Not in Blue Mountains Revised Forest Plans Area
Canyon Grasslands	Center Ridge	Not in Blue Mountains Revised Forest Plans Area

Spalding's Catchfly Occurrence within the Umatilla National Forest

Spalding's catchfly is located on the Umatilla National Forest near the far northeastern corner of the Pomeroy Ranger District. The Forest Service has mapped about 111 acres of Spalding's catchfly occupied habitat in this area. The recovery plan (USFWS 2007) includes this population in the Blue Mountains Foothills key conservation area. Some plants in this area are located in a private inholding. The area where Spalding's catchfly occurs includes portions of four open ridges on the south side of Lick Creek (Cabin, Sheep, Sourdough, and Bracken ridges) and the intervening draws that support plant communities typical of the Canyon Grasslands (USFWS 2005, Johnson and Simon 1987, Tisdale 1986). One road passes through this area following Sourdough Gulch. Three patches of Spalding's catchfly are about 100 to 130 meters southeast of the road and between 100 and 200 feet higher in elevation.

All plants are within active grazing allotments on the Umatilla National Forest. These areas have been surveyed for the presence of sensitive species, including specific surveys for Spalding's catchfly in 1997 and 2000 (USDA Forest Service 2006. The condition of grasslands in the vicinity inhabited by Spalding's catchfly is variable: the northerly slopes and ridge tops are reported in good to excellent condition (USDA Forest Service 2006), whereas exotic plants, including state listed noxious weeds, such as *Centaurea solstitialis*, have invaded the southerly slopes.

National Forest System lands that support Spalding's catchfly within the Umatilla National Forest are currently allocated to MA C3 big game winter range. Under this allocation, all management actions are suitable, including grazing. Permitted grazing utilization standards for upland grasslands in big game winter range are 55 percent for pastures in satisfactory condition and 0 to 35 percent for pastures in unsatisfactory condition. Yellow-star thistle (*Centaurea solstitialis*), an aggressive invasive plant, is a threat to the Spalding's catchfly in this area.

Spalding's Catchfly Occurrence within the Wallowa-Whitman National Forest

The recovery plan identifies four Spalding's catchfly key conservation areas in the Blue Mountains Basins physiographic region. Two key conservation areas overlap partly or almost entirely on the Wallowa-Whitman National Forest. The Crow Creek key conservation area is located largely on the National Forest, with an estimated 2,400 plants (USFWS 2007). As the third largest population range-wide, the Crow Creek key conservation area plays a leading role in the conservation of Spalding's catchfly. The Clear Lake Ridge key conservation area is distributed among National Forest System, Bureau of Land Management, and private lands. Most patches of Spalding's catchfly at Clear Lake Ridge are on private land but more than half the plants (520 of 850) grow at one patch on the Wallowa-Whitman National Forest. An additional 330 plants occupy several small patches that are predominantly on private land. A small portion of one patch overlaps with Bureau of Land Management administered land. The two other key conservation areas in the Blue Mountains Basins physiographic region do not occur on National Forest System lands. Spalding's catchfly occupied habitat totals approximately 100 acres on the Wallowa-Whitman National Forest.

The National Forest System portions of the Crow Creek and Clear Lake Ridge key conservation areas are currently allocated (under the 1990 Land and Resource Management Plan, as amended) to MA 4A General Forest Timber/Range. The maximum livestock utilization rate for upland grasses and forbs (for pastures rated in satisfactory condition) is 55 percent.

Rare plant species occurrence information is recorded by state Heritage Programs in a numbered record called an element occurrence record displayed in Table 349. Each element occurrence record may include one or more sites (often called subpopulations), which are defined as distinct patches of the plant on the landscape. The Forest Service tracks each site on National Forest System lands with its own spatial database (geographic information system) number. A systematic approach to measure population sizes began in 2008 in partnership with The Nature Conservancy. Using statistically valid methods, The Nature Conservancy measured the area, frequency, and density of Spalding's catchfly at Crow Creek and Clear Lake Ridge. Density and area measurements were used to estimate population size. Three years of results have been summarized (Jansen and Taylor 2010). The Nature Conservancy statistical population estimates exceed the values recorded by the Forest Service and approximately double both the Crow Creek and Clear Lake Ridge population estimates. The Forest Service estimated population sizes by means of walk-through visual inventories. Based on their statistical methods, the Forest Service considers the Nature Conservancy estimates to more accurately estimate population sizes. Spalding's catchfly populations on the Wallowa-Whitman National Forest appear stable or increasing where 15 to 20 years of monitoring has been done (USDA Forest Service 2008). Table 349 displays the population sizes for Crow Creek and Clear Lake Ridge key conservation areas.

All populations on National Forest System lands in Oregon are within active grazing allotments. Invasive plants threaten Spalding's catchfly at both key conservation areas on the Wallowa-Whitman National Forest. The Spalding's catchfly population within the Clear Lake Ridge key conservation area is infested with sulfur cinquefoil (*Potentilla recta*). North Africa grass (*Ventenata dubia*) is present at the Crow Creek key conservation area (Wallowa-Whitman National Forest). Annual exotic bromes (*Bromus tectorum, B. japonicus, B. secalinus*) are present at most Spalding's catchfly sites.

Table 349. Spalding's catchfly population estimates at Crow Creek and Clear Lake Ridge Key Conservation Areas

Key Conservation Area	Forest Service Population Estimate	Nature Conservancy Population Estimate
Crow Creek (East)	266-1,006	1,665-7,363 (2008) 520-2,284 (2009) 558-2,368 (2010)
Crow Creek (West)	822-2,259	2,306-7,242 (2008) 2,834-7,740 (2009) 854-3,586 (2010)
Clear Lake Ridge	750-1,970	30-1,450 (2009)

Spalding's Catchfly – Environmental Consequences

Forest Plan Components - Alternative A:

Current Forest Plans provide little specific direction for threatened and endangered species other than to repeat the requirements from law, particularly the Endangered Species Act and the National Forest Management Act. (Numbering represents plan component numbers and are not necessarily supposed to be consecutive).

Umatilla National Forest

Forestwide Standards (Forest Plan pages 4-89, 4-90)

1. Legal and biological requirements for the conservation of endangered, threatened and sensitive plants and animals will be met. All proposed projects that involve significant ground disturbance or have the potential to alter habitat of endangered, threatened or sensitive plant and animal species will be evaluated to determine if any of these species are present (FSM 2670 Threatened, Endangered and sensitive Plans and Animals).

2. Where endangered or threatened species are present, the required biological assessment process will be carried out according to the requirements of the Endangered Species Act (Public Law 93-205); consultation requirements with USDI Fish and Wildlife Service and state agencies will be met. Before the project can be carried out, protection or mitigation requirements shall be specified (36 CFR 219.27(a)(8)). Habitat for existing federally classified threatened and endangered species will be managed and monitored to achieve objectives of recovery plans.

4. For endangered, threatened and sensitive species, determine and monitor the status of populations and habitats and the strategies implement for protection. …

Wallowa-Whitman National Forest

Forest-wide Standards (Forest Plan pages 4-30, 4-31)

1. Reviews/Biological Evaluations. Review all actions and programs, authorized, funded, or carried out by the Forest Service, to determine their potential effects on threatened, endangered, and sensitive species. Conduct these reviews, including biological evaluation, per direction in FSM 2670 and appropriate R-6 manual supplements.

2. Prepare a biological evaluation during the environmental analysis of each project to determine possible effects of the proposed activity on threatened, endangered, and sensitive species.

3. Other Activities. Restrict or prohibit other activities (e.g., off-road vehicles impacting plants or habitats) and monitor activities where necessary to protect threatened, endangered, or sensitive species.

7. Inventory. . . . Corrective measures to avoid possible adverse effects on recovery of populations will be implemented.

8. Collection. Allow collection of threatened, endangered, and sensitive species only under permit in accordance with FSM 2673.

The existing Forest Plans do not provide habitat or activity specific standards and guidelines for threatened and endangered species or their critical habitat. Under Alternative A, specific mitigation measures to meet legal requirements would be identified during project-level planning and implementation. Despite the lack of specific standards and guidelines, this approach has resulted in maintaining apparently stable population trends for the Spalding's catchfly. See the discussion above under Affected Environment.

Forest Plan Components Applicable to Spalding's Catchfly - Alternative B, E, E-Modified, E-Modified Departure, and F

Please refer to Volume 4, Appendix A, Forestwide Standards and Guidelines, section 2.3, Federally Listed and Sensitive Species.

Effects to Spalding's Catchfly from Livestock Grazing

Livestock grazing can directly affect Spalding's catchfly by herbivory and trampling and indirectly impact Spalding's catchfly via soil compaction, soil erosion, the introduction of nonnative plants, and loss of pollinator habitat. Grazing of Spalding's catchfly has been observed and is considered a threat to the species (Kagan 1989, Hill and Gray 2004, Taylor 2007). Direct herbivory removes flowers or seeds, thereby limiting reproduction. Herbivory of leaves inhibits a plant's ability to manufacture carbohydrates necessary for seasonal growth and storage in the perennial taproot. Trampling can easily break off entire plants at the ground level and damage the root crowns from which stems emerge. Root crown damage is more frequently associated with early season grazing (Hill and Gray 2004). Late summer grazing or heavy grazing is especially detrimental to Spalding's catchfly (Hill and Gray 2004). In one study (Cullen et al. 2011) browse rates could not be correlated to cattle stocking rates. Their results suggested cattle did not consume significant numbers of catchfly plants during the peak summer growth period, but the authors could not conclude that grazing does no harm to populations of the plant. That study measured stocking as animal units/time period and not percent forage utilization or stubble height, so it is not possible to compare these results to the utilization standards proposed in the revised plans. Another study (Dingledein et al. 2010) found significant browse of catchfly plants throughout the growth season ranging from 20 to 71 percent, although this was attributed largely to wild ungulates, because the study area was not grazed by livestock during the investigation. Sufficient research has not been completed to discern what levels of grazing may allow the Spalding's catchfly to persist (USDI 2007).

Indirect effects can impact the habitat of Spalding's catchfly. Although grassland ecosystems of the arid intermountain west experienced little grazing pressure from large hoofed animals during the last 10,000 years (Mack and Thompson 1982, Lyman and Wolverton 2002) they cannot tolerate the levels of grazing exerted by domestic livestock in the 1800s and early 20th century. Both *Pseudoreigneria spicata* and *Festuca idahoensis* are poorly adapted to herbivory by comparison to other grass species, having little compensatory growth, such as tiller production

(Caldwell et al. 1981). Disturbances, most frequently linked to adverse livestock grazing and trampling, have dramatically altered western arid ecosystems in a progression from native perennial bunchgrass communities to invasive nonnative annual grasslands that are then susceptible to more invasive perennial plant invasions (DiTomaso 2000).

Of greater concern is the impact livestock grazing may have on the pollinator community in Spalding's catchfly habitat. Kimoto and others (2012) found that even where catchfly plants had not been fed on by livestock, grazing of habitat reduced pollinator abundance, thereby limiting seed production. Described as the first large-scale manipulative study of the effect of grazing intensity on native bee communities in a North American grassland, Kimoto (2010) found that increases in grazing intensity showed a linear decline in bee diversity, abundance, and richness, especially with bumblebees (*Bombus* spp.), which include the main pollinator of Spalding's catchfly, the yellow bumblebee (*Bombus fervidus*), identified as the most significant pollinator (*B. fervidus*) of Spalding's catchfly (Lesica and Heidel 1996, Taylor and DeBano 2012, Tubbesing et al. 2014). In the absence of open pollination, Spalding's catchfly experienced an 85 percent reduction in fecundity and a loss of fitness, due to inbreeding depression, resulting in an estimated total reduction in fitness of 99 percent (Lesica 1993). Therefore, management practices that significantly reduce pollinators, especially bumblebees, could have a significant impact on the recruitment of new plants into a Spalding's catchfly population. Even though Spalding's catchfly is long lived, without seedling recruitment, populations would decline over time. Forage utilizations approaching 50 percent showed very little to no bumblebee abundance (Kimoto 2010). Therefore, grazing utilization of 50 percent within Spalding's catchfly populations and surrounding habitat would not likely contribute toward maintaining bumblebee populations, thereby limiting Spalding's catchfly reproduction. Kimoto (2010) found that even moderate grazing (22 to 40 percent utilization) led to bumblebee declines.

Effects to Spalding's Catchfly - Alternative A

Under Alternative A – No Action, known Spalding's catchfly plants would be within the management allocations suitable for livestock grazing. The general effects of grazing to Spalding's catchfly are outlined above. Specific project design features to facilitate the conservation and recovery of the catchfly would be determined during subsequent project level planning.

Effects to Spalding's Catchfly - Alternatives B, D, E, and F

On the Wallowa-Whitman National Forest, known Spalding's catchfly populations occupy land management allocations that would be suitable for livestock grazing. Direct and indirect effects could occur to populations of the species. As projects are planned or revised (including ongoing actions that would be brought into compliance with the Forest Plan upon implementation), livestock grazing actions would need to comply with standard FLS-15S that would restrict the timing of livestock grazing in occupied habitat to outside the growing season for Spalding's catchfly (generally May 15 through August 30) for pastures in satisfactory condition (low departure from the upland grassland desired condition). For pastures in unsatisfactory condition (moderate or greater departure from the desired condition) grazing would be avoided entirely in pastures inhabited by Spalding's catchfly (Standard FLS-16S). These two standards would ensure that Spalding's catchfly would not be grazed or trampled and that occupied habitat in moderate or greater departure from the upland grassland desired condition would not be grazed to facilitate its transition to phase A or B faster than if it were grazed.

On the Umatilla National Forest, for Alternatives B, D, E, and F, nearly all the known sites of Spalding's catchfly would be within the proposed Sourdough botanical area (MA 2C), where livestock grazing would not be a suitable activity. Two Spalding's catchfly patches composed of about 200 plants (roughly 3 percent of the Spalding's catchfly plants within the Umatilla National Forest) occupy an area north of the proposed botanical area. These two patches would be in MA 4A General Forest for all alternatives. Therefore, livestock grazing would not affect the majority of the known population of Spalding's catchfly within the Umatilla National Forest for these alternatives.

About three percent of the Spalding's catchfly population that grows outside the proposed botanical area could be affected by grazing. Under Alternatives B, E, and F, Spalding's catchfly plants would be managed according to standards FLS-15S and FLS-16S as described above for the Wallowa-Whitman National Forest. Under Alternative D, no such standards apply to grazing activities in Spalding's catchfly occupied habitat. The small, three-percent proportion of catchfly growing outside the proposed botanical area could be grazed to a maximum 50 percent utilization for management systems that incorporate rest, rotation or deferment. This could impact the species; however, with the vast majority (97 percent) of the catchfly population in a botanical area that is not suitable for livestock grazing, no impacts to viability or recovery would be expected.

Effects to Spalding's Catchfly - Alternative C

Under Alternative C, all known Spalding's catchfly sites within the Umatilla National Forest would be allocated to a wilderness study area, where livestock grazing would become a suitable use at a maximum 25 percent utilization of key forage species. This relatively light level of grazing, even during the active growth period for the catchfly, would be expected to maintain populations of the plant species. At this relatively light level of grazing, little direct herbivory and trampling to the catchfly would be expected.

Effects to Spalding's Catchfly Common to Alternatives E-Modified and E-Modified Departure

Plan components for livestock grazing that contribute to Spalding's catchfly conservation:

- FLS-15S (Standard): Livestock grazing of occupied *Silene spaldingii* habitat shall not be authorized between July 1 and September 30 (flowering-fruiting period).
- FLS-3S (Standard): Maximum utilization of key forage species shall not exceed 30 percent in occupied habitat of threatened, endangered, proposed or candidate plant species, except where an approved conservation strategy, conservation agreement, or recovery plan recommends an alternate use level.
- FLS-5G (Guideline): New water developments and salting should not be authorized within one-quarter mile of occupied habitat of threatened, endangered, candidate or sensitive plant species to reduce concentrated livestock use and its associated impacts, e.g., excessive trampling, soil compaction and herbivory.

FLS-15S would allow the Spalding's catchfly to complete its reproductive cycle: flowering, pollination-fertilization, fruit-seed maturation and seed dispersal. Spalding's catchfly begins seasonal growth from late May into June as a rosette with foliage near the ground. By late June stem elongation and growth of floral buds has begun (Dingledein et al. 2010). A browse study conducted on the Zumwalt Prairie Preserve in northeastern Oregon concluded that livestock were not significant factor affecting the browse rate of Spalding's catchfly (Cullen et al. 2011).

This study, conducted during the period of June to mid-July, corroborates what Forest Service botanists observe: early season grazing has little direct effect to the catchfly, with few plants observed being browsed (Hustafa pers. comm.). This is likely due to the fact that at this time, catchfly plants are in the rosette stage, near the ground surface and below the reach of livestock that browse on the taller lush, green, abundant prairie grasses of the early season. As the season progresses, however, browse rates on the catchfly, from both livestock and wild ungulates, increase (Kimoto et al. 2012). Ceasing grazing in occupied Spalding's catchfly habitat from July 1 through September 30 would remove the threat of direct and indirect threats of browsing and trampling, thereby allowing catchfly plants to flower, be pollinated, and mature the capsules to the point of dehiscence and seed dispersal.

FLS-3S is designed to moderate grazing utilization and reduce associated effects of trampling, maintain or improve grassland vigor and health, and maintain other pollinator host plants. Some studies show that moderate grazing can maintain or improve the forb component of grasslands but scientists caution that grazing should be carefully planned to the specific plants and pollinators of an area (Black et al. 2011). While Kimoto (2010) observed declines in bumblebee abundance at grazing utilization levels of 22 to 40 percent, a relatively light maximum utilization rate of 30 percent for a portion of the season before or after the Spalding's catchfly main growing season would not be expected to drive bumblebee abundance or their host plants to detrimentally low numbers.

FLS-5G is designed to reduce concentrations of livestock in occupied habitat by placing salt and water, both strong attractors of livestock, away from Spalding's catchfly populations.

These three mitigation measures are expected to reduce, if not eliminate, the herbivory of Spalding's catchfly by livestock and result in infrequent, incidental trampling impacts, while maintaining the grassland habitat including pollinator host plants.

Effects to Spalding's Catchfly from Invasive Plants

Effects from All Alternatives

Exotic, invasive plant species threaten the viability of Spalding's catchfly. Invasive plants compete with Spalding's catchfly for water, nutrients, and light. Of greatest concern is the effect of invasive plants on seedling establishment, a vulnerable state for perennial plants. Not only are invasive species able to outgrow seedlings of Spalding's catchfly, they often leave behind increased leaf litter, inhibiting the germination of other plants. In one study in Washington, high levels of exotic plants (*Bromus secalinus, Hypericum perforatum,* and *Ventenata dubia*) were associated with less vigorous occurrences of Spalding's catchfly (Caplow 2002). Invasive plants also provide competition for pollinators, affecting fecundity and individual fitness in Spalding's catchfly (Lesica and Heidel 1996). Insects may switch from Spalding's catchfly to an invasive plant if it is more abundant or provides more pollen or nectar (Richards 1997). Lesica and Heidel (1996) found lower visitation rates for Spalding's catchfly in sites infested with *Hypericum perforatum* (St. John's wort).

With the increased level of activity expected for Alternative D, the risk of increased invasive plant spread would be more likely compared to the other alternatives. See the Non-native Invasive Plants section for a discussion of these effects from invasive species.

Forest plan objective 1.5, "Reduce current infestations of invasive plant species," would contribute to the conservation of Spalding's catchfly by reducing or eliminating invasive species

in and around occupied habitat. Invasive plant treatment actions designed to reduce or eliminate infestations may affect Spalding's catchfly. The main concern here is the use of herbicides to treat invasive plants, which, if applied indiscriminately, may cause mortality or damage to Spalding's catchfly. For Alternatives A, B, C, D, E, and F, proposed Forest Plan components would address this concern by incorporating existing Forest Plan standards, as amended by the 2005 Record of Decision for the Preventing and Managing Invasive Plants Final Environmental Impact Statement. The 2005 plan amendment (standard no. 20) directs invasive plant treatments be designed to minimize or eliminate adverse effects to species or habitats proposed or listed under the Endangered Species Act. Forest plan standard RE-5S proposed under Alternative E-Modified and E-Modified Departure is similar to this direction:

> Minimize adverse effects to ESA listed, proposed, and candidate species and their designated and proposed critical habitat in accordance with Forest Service authorities. Management activities shall not retard recovery of listed, proposed, and candidate species and their designated and proposed critical habitat in the long-term in accordance with Forest Service authorities. Federally listed, proposed, and candidate species and their designated and proposed critical habitats shall be managed in accordance with their recovery or other conservation plans.

Both standard RE-5S and the 2005 plan amendment standard no. 20 would insure that as invasive plant treatment projects are planned and implemented, adverse effects to Spalding's catchfly would be minimized and options for recovery would not be retarded.

Effects to Spalding's Catchfly from Prescribed Fire

Although the actual effects of prescribed fire is unknown, Spalding's catchfly is presumed to have evolved with and adapted to the historical fire regime in intermountain western North America (Lesica 1999), where fire has been a common occurrence in grasslands (Barrett and Arno 1982). Historical fire frequency in the Idaho fescue grasslands of the Blue Mountains is not well understood, but it is believed fires were frequent, with return intervals of less than 35 years (Johnson and Swanson 2005). Late summer fires are more damaging to Idaho fescue, but pre-burn cover of fescue returns usually within five years (Johnson and Swanson 2005). In the Idaho fescue grasslands of northeastern Oregon and southeastern Washington, fire is not believed necessary to promote seedling establishment of Spalding's catchfly as it apparently is in the western Montana grasslands dominated by rough fescue (Lesica 1999). Drier conditions in northeastern Oregon and southeastern Washington also limit the ability of trees and shrubs to encroach onto grasslands. Therefore, prescribed fire may not be needed to maintain grasslands in northeastern Oregon and southeastern Washington. If prescribed fires are needed to improve habitat for *S. spaldingii*, they would be carried out during the early spring or fall, when fires are more easily controlled. Fires carried out in the fall would probably have less impact to *S. spaldingii* than fires carried out during spring, when it is possible seedlings could be killed. Dormant plants would probably not be affected, and older plants emerging from root crowns may suffer only minor damage. Perennial individuals damaged by spring fire are expected to send up additional shoots from axillary buds.

Effects of the Plan Revision Alternatives

Forest plan standard FLS-7G would require federally listed, proposed or candidate plants be avoided by the construction of slash piles or other fuels to protect plants from the extreme temperatures that develop underneath or next to them. Guideline FLS-8G would require federally listed, proposed or candidate plants be avoided by the construction fire suppression lines for both planned (prescribed) and unplanned fires (wildfire). The overall effect of prescribed fire would

benefit *S. spaldingii*, though some individual plants may be adversely affected in the short-term. For Alternatives E-Modified and E-Modified Departure, these two standards and guidelines have been reworded, labeled differently, but have the same direction and intent. (See FEIS Volume 4, Appendix A, Forestwide Standards and Guidelines, 1.3. Federally Listed Species.)

These standards and guidelines would permit prescribed fire for situations that may benefit the Spalding's catchfly or its habitat, for example, by encroachment from shrubs, such as snowberry or ninebark. The net long-term effect of prescribed fire would benefit *S. spaldingii*, though some individual plants may be adversely affected in the short-term.

Effects to Spalding's Catchfly from Climate Change

The effects of climate change are speculative, but it has the potential to affect rare plants, including Spalding's catchfly. Researchers speculate that a warming climate will alter precipitation patterns, with some regions becoming drier and others wetter. Within the Pacific Northwest, a recent model predicts warmer and wetter winters in 80 years. Being stationary, plants must migrate through dispersal, colonization and recruitment strategies, a relatively slow process compared to mobile organisms. Some researchers believe that plant species will not be able to migrate at a pace dictated by a warming climate, which would isolate and eventually doom some species, unless new adaptations arise to cope with a changing environment. Even though activities would be designed to maintain or improve Spalding's catchfly habitat or numbers, these actions may cause short-term adverse effects. Restorative actions, such as prescribed fire or collecting *S. spaldingii* seed for long-term storage, could cause short-term adverse effects, even though the overall effect of these actions would be beneficial.

Cumulative Effects to Spalding's Catchfly

The effects area includes lands within the proclaimed boundaries of the Umatilla and Wallowa-Whitman National Forest and adjacent lands. Tribal lands exist adjacent the National Forests on the Confederated Tribes of the Umatilla Indian Reservation and the Nez Perce Precious Lands. Most catchfly populations are near the forest boundaries of both the Umatilla and Wallowa-Whitman National Forests. Actions on adjacent nonfederal lands have a possibility to affect catchfly populations on National Forest System lands, but likely only for those populations nearest the forest boundaries. It is not possible to state what actions are likely to occur on adjacent private or tribal lands, but we assume these lands would be managed as they are today. The nonfederal action most likely to affect catchfly plants on adjacent National Forest System lands is invasive plant control on adjacent private and tribal lands, as well as county and state roads leading to and coursing through the National Forests. Active weed management programs on adjacent private and tribal lands, as well state and local government roadside weed control, would likely benefit catchfly habitat on federal lands because fewer weed propagules would be available for transport, whether by people, vehicles, wind or wildlife, and establishment in catchfly habitat on the National Forests. The effects of other management activities on adjacent private, state and tribal lands is expected to be confined to those lands and not overlap in time and space with catchfly populations on National Forest System lands. The management direction for the Hells Canyon National Recreation Area would be additive to the direction under the proposed action and alternatives. Standards and guidelines for the management of livestock grazing and invasive plant control within the national recreation area would complement direction under the plan revision alternatives for the Blue Mountains Forest Plan Revision.

Determination for Spalding's Catchfly

A biological assessment for the purposes of Section 7 consultation under the Endangered Species Act has been prepared: the anticipated determination for the Forest Plan components of goals, objectives, standards and guidelines, and suitability determinations for management areas for activities that may be conducted within the Wallowa-Whitman National Forest and the Umatilla National Forest, for any of the alternatives, is "may affect, likely to adversely affect" Spalding's catchfly. Though many management actions, such as nonnative invasive species abatement or prescribed fire, would assist in the recovery of Spalding's catchfly, these actions may have short-term adverse effects that may impact individual plants or their habitat, while promoting the long term recovery of the species. The findings of the project biological opinion from the U.S. Fish and Wildlife Service will be reported in the project record of decision.

MacFarlane's Four O'clock – Affected Environment

MacFarlane's four o'clock (*Mirabilis macfarlanei*) is a rare plant narrowly endemic to a small range (46 by 29 km) in northeastern Oregon and adjacent west-central Idaho. MacFarlane's four o'clock was listed as endangered under the Endangered Species Act in 1979. As more populations were discovered, MacFarlane's four o'clock was downgraded to threatened status (61 FR 10693-10697). Populations of the four o'clock have not been discovered within the Plan Area but are located in the adjacent Hells Canyon National Recreation Area. The nearest population is approximately 25 miles to the southeast in the Imnaha River canyon. Suitable habitat for the species exists within the Plan Area on the Wallowa-Whitman National Forest.

MacFarlane's four-o'clock is a perennial forb in the Nyctaginaceae or four-o'clock plant family. New shoots emerge in the early spring from tuberous rootstock with flowers blooming from late May to early June. Each flower produces only one barrel-shaped achene: a single seeded fruit about 6mm long. Seeds typically disperse via gravity from late June through July and plants senesce shortly thereafter. Seedling establishment is apparently infrequent; most reproduction is accomplished asexually via tuberous-thickened roots that continue to grow in several directions sending up new stems.

MacFarlane's four-o'clock grows predominantly in blue-bunch wheatgrass grasslands below 3,000 feet in the canyon grasslands ecological type described by Tisdale (1986). Suitable habitat for Macfarlane's four o'clock within the Wallowa-Whitman National Forest has been identified using a model (Murray 2001). Physical and biological attributes from known Macfarlane's four o'clock sites, including vegetation type, elevation, slope and aspect, were weighted and used to map areas that have the potential to support the species. Murray (2001) categorized potential habitats by probability as moderate, high, or very high. The purpose of the model is to identify areas to prioritize field inventories for Macfarlane's four o'clock; it does not definitively identify suitable habitat, whether or not the habitat is occupied. The model ranks eleven of twelve known Macfarlane's four o'clock occurrences in the Hells Canyon National Recreation Area as very high potential (eight occurrences) or high (three occurrences) potential habitat. One four o'clock site in the Hells Canyon National Recreation Area inhabits an area not predicted by the model. Although the model adequately predicts suitable habitat to direct inventories, it cannot be relied upon to confirm or rule out suitable habitat for the species.

Within the Plan Area portion of the Wallowa-Whitman National Forest, the model identifies 1,258 acres of high potential habitat. The model does not identify very high or moderate potential habitat within the revised Forest Plans area. A survey completed in 2004 in MacFarlane's four o'clock potential habitat in the Joseph Creek canyon (USDA Forest Service 2005e) did not detect

new occurrences. This survey was conducted in what is likely the best available habitat within the Plan Area and nearest the known range of the four o'clock. Additional surveys conducted in 2007, 2008, 2009, and 2010 of MacFarlane's four o'clock in very high and high potential habitat within the Snake River canyon did not detect new occurrences. Based on the negative survey findings in the Plan Area and in the Snake River canyon, it is unlikely that MacFarlane's four o'clock occurs within the Plan Area.

Macfarlane's Four O'clock – Environment Consequences

Determination for Macfarlane's Four O'clock

MacFarlane's four-o'clock is not known to be present in the Plan Area and, based on prior surveys, is unlikely to inhabit the Plan Area. Because the species is not likely to be present, potential effects to the species from any of the alternatives are not expected to occur. The action of adopting forest plan components—desired conditions, goals, objectives, standards and guidelines—is expected not to affect the MacFarlane's four-o'clock. If, during the life of the Plan, the MacFarlane's four-o'clock were to be discovered in the Plan Area, then the same plan components for federally listed plants (except PL-TES-1 and FLS-S3, both which apply specifically to Spalding's catchfly) would apply during the development and implementation of site-specific project actions. However, based on the best available science, the action of revising the Forest Plan for all alternatives would result in no effect to the MacFarlane's four-o'clock.

Sensitive Plants

Habitat Groups for Sensitive Plant Species

To facilitate analysis, sensitive species are grouped into 14 habitat groups. These habitat groups are present throughout the Blue Mountains on each of the three National Forests in the analysis area.

- Alpine fellfields and subalpine parkland
- Aspen, cottonwood
- Conifer forest
- Sagebrush shrubland
- Grassland
- Basalt lithosol
- Talus, cliffs, and rock outcrops
- Aquatic
- Peatlands
- Seep/spring
- Riparian
- Intermittent stream
- Moist meadow
- Wet meadow

For sensitive plants, one of the following effects determinations are made for species in each of the habitat groups (Salwasser et al. 1995):

- **No impact (NI) -** a project or activity will have no environmental effects on habitat, individuals, a population or a species.
- **May impact individuals or habitat, but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species (MIIH) -** activities or actions that have effects that are immeasurable, minor or are consistent with conservation strategies would receive this conclusion.
- **Will impact individuals or habitat with a consequence that the action may contribute to a trend towards federal listing or cause a loss of viability to the population or**

species (WIIH) - Loss of individuals or habitat can be considered significant when the potential effect may (1) contribute to a trend toward federal listing (C-1 or C-2 species); (2) result in a significantly increased risk of loss of viability to a species; or, 3) result in a significantly increased risk of loss of viability to a significant population (stock).

- **Beneficial impact** (BI) **-** Projects or activities that are designed to benefit, or that measurably benefit a sensitive species should receive this conclusion.

Findings of the analysis are summarized in Table 350. The analysis of effects, by habitat group, follows.

Table 350. Biological evaluation findings for sensitive plants by habitat group

Habitat Group	Alt. A	Alt. B	Alt. C	Alt. D	Alts. E, E-Mod., & E-Mod. Departure	Alt. F
Alpine fellfields and subalpine parkland	MIIH	MIIH	MIIH	MIIH	MIIH	MIIH
Aspen, cottonwood	MIIH	MIIH	MIIH	WIIH	MIIH	MIIH
Conifer forest	MIIH	MIIH	MIIH	WIIH	MIIH	MIIH
Sagebrush shrubland	MIIH	MIIH	MIIH	WIIH	MIIH	MIIH
Grassland	MIIH	MIIH	MIIH	WIIH	MIIH	MIIH
Basalt lithosol	MIIH	MIIH	MIIH	WIIH	MIIH	MIIH
Talus, cliffs, and rock outcrops	MIIH	MIIH	MIIH	MIIH	MIIH	MIIH
Aquatic	MIIH	MIIH	MIIH	MIIH	MIIH	MIIH
Peatlands	MIIH	MIIH	MIIH	WIIH	MIIH	MIIH
Seep/Spring	MIIH	MIIH	MIIH	WIIH	MIIH	MIIH
Riparian	MIIH	MIIH	MIIH	MIIH	MIIH	MIIH
Intermittent Spring	MIIH	MIIH	MIIH	MIIH	MIIH	MIIH
Moist Meadow	MIIH	MIIH	MIIH	MIIH	MIIH	MIIH
Wet meadow	MIIH	MIIH	MIIH	WIIH	MIIH	MIIH

Alpine Fellfields and Subalpine – Parkland Affected Environment

Alpine areas are lands above the timberline. Within the Plan Area, these are found on the highest peaks of the Wallowa Mountains, Elkhorn Mountains, Greenhorn Mountains, and Strawberry Mountain. Fellfields are among the dominant vegetation community in alpine areas. Fellfields are characterized by stony soils that support sparse vegetation. Subalpine parklands are treeless plant communities at or immediately below the timberline. Subalpine parkland is more widespread than alpine areas in the Blue Mountains. Parkland can be found throughout the Wallowa and Elkhorn Mountains; it becomes less a feature of the landscape to the south and west as elevations and precipitations decline; though they are a feature in the Greenhorn Mountains and the Strawberry Mountains. The plant communities in parkland may be similar to fellfield, but the meadows that dominate parkland are usually lusher than fellfields.

Nearly all species listed for alpine fellfields and subalpine parkland are confined to designated wilderness areas. The few exceptions are discussed further:

Greenman's desert parsley (*Lomatium greenmanii*): One population, the largest known, is located on the summit plain of Mount Howard, just north of the Eagle Cap Wilderness Area in the Wallowa Mountains. Two other populations are found within the Eagle Cap Wilderness Area. The current land allocation is backcountry.

Red-fruited desert parsley (*Lomatium erythrocarpum*): All known sites of this narrow endemic are in the Elkhorn Mountains. The current land allocation is backcountry.

Table 351. Alpine fellfields and subalpine parkland habitat group description for each species

Scientific Name	Habitat Description	Malheur	Umatilla	Wallowa-Whitman
Bupleurum americanum	Subalpine fellfields. Talus slopes, rocky soils, dry meadows, ridge tops. Can be in a mosaic of open areas, and scrubby coniferous forest. Generally north to northwest aspect. Coarse gravel; granodiorite and basaltic lithosols.	A	A	D
Carex nardina	Exposed arctic and subalpine tundra, usually calcareous, cliffs, rocky slopes, ridges, and summits 50-3,300 meters. Population is in the dark sedimentary rocks of Hurwal formation. Habitat well distributed. Plant not well distributed across habitat.	A	A	D
Carex pelocarpa	Alpine slopes, ridge crests, rocky lakeshores 2,700-3,700 meters. Ours are on fellfield in lower sedimentary series, scattered in alpine depression, and on streambanks. Not clear if always on calcareous soils.	A	A	D
Carex pyrenaica ssp. micropoda	Moist meadows, stream banks, seeps, snowbeds, and areas irrigated by meltwater 10-4,000 meters. Boulder talus.	A	D	D
Carex vernacula	Moist alpine tundra, moist forest openings just below treeline. High elevation only, 2,000-3,800 meters.	S	D	D
Castilleja fraterna	Open, exposed, bare rock and talus in sub-alpine tundra. Damp sub-alpine meadows and streambanks. Restricted to calcareous substrates; both sedimentary soils and Martin-Bridge limestone outcrops. Wallowa Mountains endemic.	A	A	D
Castilleja rubida	Talus, alpine fellfields. Wallowa Mountains endemic. Open, exposed bare rock on calcareous substrates. Hurwal sedimentary soils and Martin-Bridge limestone outcrops. Alpine tundra habitat w/low grasses, sedges, and forbs. All aspects and slopes.	A	A	D
Cymopterus nivalis	Open rocky places. Moderate to high elevations.	D	S	S
Kobresia myosuroides	Tundra, grassland, heaths, bare rocky, dry to wet ground; zero-3,500 meters (18). Moist meadows, seeps, riparian areas. Often above timberline; high elevations only in Blue Mountains.	A	A	D
Kobresia simpliciuscula	Fens, marshes, mesic to wet tundra, gravels, rocky slopes, usually on calcareous substrates; zero-3,500 meters. Moist meadows, seeps, riparian areas. Streamsides, bogs, pond edges. Moderate to high elevations in Wallowa Mountains.	A	A	D

Scientific Name	Habitat Description	Malheur	Umatilla	Wallowa-Whitman
Lomatium erythrocarpum	Ridges, fine argillite talus, open slopes. Mostly on steep slopes, with very little vegetation. Alpine knotweed (*Polygonum phytolaccaefolium*) is often associated. Most populations are south or east facing. High elevation in southern Elkhorn Mountains only.	A	A	D
Lomatium greenmanii	Subalpine grasslands on sedimentary rocks at basalt interface. Ridges, fine basalt-derived talus, open slopes. High Wallowa Mountains endemic. Soils are thin and fine textured.	A	A	D
Phlox hendersonii	Alpine fellfields, open gravely slopes and ridges. Glacial moraines.	S	A	D
Pinus albicaulis	Forms stands and individual small clumps at uppermost elevation tree limit or single, isolated trees in the alpine zone	D	D	D
Saxifraga adscendens ssp. oregonensis	Rock crevices, glacial moraines, alpine meadows, along streams. Damp cliffs where soil has accumulated. High elevations only. Recent sites in Wallowa Mountains are in limestone, reported also on quartzite and gneiss in Idaho.	S	A	D
Townsendia alpigena var. alpigena	Meadows, granite and limestone ridges; 2,000-3,100 meters. Rocky, dry areas, high elevations only.	A	A	D
Townsendia parryi	Meadows, grassy slopes, gravelly benches, talus; 1,500-3,000 meters. Rocky, dry areas, high elevations only here.	A	A	D

D: documented within the national forest, S: suspected to occur within the national forest; A: absent.

Alpine Fellfields and Subalpine Parkland – Environmental Consequences

Indirect Effects

Wilderness area management retains the 1990 Forest Plan direction in all alternatives except for two instances in Alternative C. For Alternative C, two guidelines from 1990 management direction that are retained in Alternatives B, D, E, E-Modified, E-Modified Departure, and F become standards. One current guideline would, as a standard, require new proposals for outfitter and guide special use permits, or recreation event permits, be approved only when the special use or event is consistent with wilderness area desired conditions and a need is identified by a needs assessment and capacity analysis. The second guideline, as a standard under Alternative C, would prohibit camping and campfires within 200 feet of lakes, streams or other camps. This second standard, under Alternative C, would better protect sensitive species with habitat near water bodies within alpine areas and subalpine parkland. Otherwise, the 1990 management direction for congressionally designated wilderness areas, retained for Alternatives B, D, E, E-Modified, E-Modified Departure, and F, would more than meet the desired condition for sensitive species within alpine areas and subalpine parkland. In congressionally designated wilderness areas timber production, timber harvest, motor vehicle use, road construction, mechanical fuel treatment, and energy development are unsuitable uses, under all plan revision alternatives. In effect, congressionally designated wilderness areas serve as reserves for rare plant species, as well as for many other natural resources. It is possible that sensitive plants inhabiting alpine environments in wilderness areas may be affected by authorized activities; however, these impacts are expected to be minor and not result in a loss of population viability within the Plan Area. New trail

construction would have to comply with guideline FLS-11S, directing that new trail construction avoid threatened, endangered, or sensitive plant locations to minimize adverse effects to the occupied habitat of sensitive plant species, including the Greenman's desert-parsley, under alternatives B, E, and F or as a standard under Alternatives E-Modified and E-Modified Departure.

For the populations of Greenman's desert-parsley outside wilderness areas, the alternatives vary in land management allocations and suitability of uses. In the Alternatives B, E, E-Modified, E-Modified Departure, and F, the allocation is MA 3B Backcountry (motorized use). Under Alternative D the proposed allocation is MA 4A General Forest. Alternative C would include this area as MA 3A Backcountry (nonmotorized use). The suitable uses vary from grazing being the only suitable use under Alternative C to all uses under Alternative D. Given the subalpine habitat of the species and its current range outside of wilderness that is restricted to Mount Howard, impacts from recreation uses would be the only activity likely to impact the species. Impacts from new trail construction would be addressed with guideline FLS-11S (Alternatives B, E, and F) or as a standard (FLS-11S - Alternatives E-Modified and E-Modified Departure) that direct new trail construction to avoid the occupied habitat of sensitive plant species to minimize adverse effects to the occupied habitat.

In the case of red-fruited desert parsley (*Lomatium erythrocarpum*), Alternatives B and D would retain 1990 management direction of limited motor vehicle use in a backcountry area (MA 3B) within the area of the plant's habitat. Alternative E, E-Modified and E-Modified Departure would designate this area as nonmotorized backcountry area (MA 3A), while Alternative C would include the area containing the species' habitat within a preliminary administratively recommended wilderness area (MA 1B). Each of these management allocations restricts management to a lesser or greater degree and, with the possible exception of motor vehicle trail use under Alternatives A, B, and D, none of the designated suitable uses under any alternative poses a threat to the species. Existing hiking trails already provide access to the area occupied by red-fruited desert parsley. Any new trail construction would be directed by guideline FLS-11S (Alternatives B, E, and F) or as standard FLS-11S (Alternatives E-Modified and E-Modified Departure) that direct new trail construction to avoid the occupied habitat of sensitive plant species, including the red-fruited desert parsley, to minimize adverse effects.

Biological Evaluation Finding for All Alternatives

Given the preponderance of alpine fellfield and subalpine parkland habitat is in wilderness (MA 1a) the implementation of the alternatives may impact individuals or habitat, but would not likely contribute to a trend towards Federal listing or cause a loss of viability to the population or species.

Conifer Forest – Affected Environment

The conifer forest habitat group includes all types of forest, from dry ponderosa pine forest to the relatively moist subalpine fir and mountain hemlock forests. Sensitive species that inhabit conifer forest are listed in Table 352.

Conifer Forest – Environmental Consequences

Indirect Effects of Alternatives A, B, E, E-Modified, E-Modified Departure, and F

Timber harvest, livestock grazing, and prescribed fire are the principal threats to sensitive plants that inhabit the conifer forest group. The Forest Plans would respond to these threats with

guidelines for Alternatives B, E, and F that would require sensitive plants to be buffered (minimum 100 feet) from timber harvest and associated activities (FLS-6S) and piling and burning of slash (FLS-7G), and it would limit the maximum utilization of key forage species (grasses) to 30 percent (FLS-4G) Although some individual plants may be impacted by subsequent project actions, these guidelines would be expected to maintain the populations of species in the conifer habitat group.

Table 352. Conifer forest habitat group description for each species

Scientific Name	Habitat Description	Malheur	Umatilla	Wallowa-Whitman
Allium campanulatum	Dry ponderosa pine forest, margins of ponderosa stands adjacent to sagebrush openings; mountain big sagebrush above treeline.	A	D-WA	A
Botrychium paradoxum	In snowfields, secondary growth of pastures; 1,500-3000 meters. Moist meadows, riparian zones, moist roadsides. Montane to subalpine grasslands or forb dominated meadows. In openings and on edges of cold coniferous forests.	S	D	D
Botrychium ascendens	Moist meadows, riparian zones, moist roadsides, openings in cold forests. Often in calcareous soils, but not always. Lower montane, mesic coniferous forest and grassy fields.	D	S	D
Botrychium pedunculosum	Brushy secondary-growth habitats along streams and roadsides. Moist meadows, riparian zones, moist roadsides. Sometimes in openings or on edges of cold coniferous forest	S	D	D
Carex cordillerana	Naturally disturbed rocky slopes with organic layer and leaf litter in mesic mixed forests, or disturbed, open grassy slopes; 500-2,400 meters. Moist, shady woods; warm-moist plant associations. Found in aspen being taken over by Douglas-fir in Washington.	D	D	D
Collomia mazama	In southern Oregon Cascades, C. mazama inhabits high elevation (1,500-2,000 meters) forest-meadow ecotones in the red fir/mountain hemlock and lodgepole pine forest zones and occasionally along riparian areas.	D	A	A
Cypripedium fasciculatum	Coniferous forest - moist coniferous forest usually at lower third of slope or riparian conifer forest bottomland.	A	D	S

D: documented within the national forest, S: suspected to occur within the national forest; A: absent.

Alternatives E-Modified and E-Modified Departure provide modified standards and guidelines for sensitive plants. Populations of sensitive plants would be avoided by project actions (FLS-6S, FLS-7G, FLS-8G) unless the harvest and burn prescriptions would benefit the sensitive plant species. Buffer widths, where needed to protect sensitive plants, would be determined during project planning. Though some individual plants may be impacted by subsequent project actions, these guidelines would be expected to maintain the populations of species in the conifer habitat group.

Biological Evaluation Finding for Alternatives A, B, E, E-Modified, E-Modified Departure, and F

Even with the varying anticipated activity levels among the alternatives, the plan revision alternatives do not vary in the biological evaluation finding of may impact individuals or habitat, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species. This is because standards and guidelines minimize impacts to sensitive species, regardless of activity levels.

Indirect Effects of Alternatives C and D

Alternatives C and D have no standards and guidelines specific to sensitive plants. Alternative C, having a relatively low predicted annual timber harvest (41 million board feet among the three National Forests) and least amount of livestock grazing (approximately 96,000 animal unit months), would have fewer impacts compared to Alternative D projects the greatest amount of predicted annual timber harvest (353 million board feet) and livestock grazing (162,145 animal unit months). Without additional standards and guidelines to conserve sensitive plants under Alternative D, sensitive plants inhabiting the conifer forest habitat group may be impacted to the degree that the action may contribute a loss of viability to the populations in the Plan Area. Alternative C, with the least amount of projected activity levels, although lacking standards and guidelines for the conservation of sensitive plants, would likely impact individuals or habitat, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species in the Plan Area.

Biological Evaluation Finding for Alternative C

This alternative may impact individuals or habitat, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species in the Plan Area.

Biological Evaluation Finding for Alternative D

This alternative will impact individuals or habitat with a consequence that the action will contribute to a trend towards federal listing or cause a loss of viability to the population or species.

Aspen and Cottonwood – Affected Environment

Species that occur in aspen (*Tortula mucronifolia*) and cottonwood (*Carex cordillerana*) communities are listed in Table 353. Aspen and cottonwood communities are classified within the warm riparian forest potential vegetation group (Countryman 2010). Patch sizes in these communities are usually less than 40 acres in size. Some stands within the Wallowa-Whitman National Forest are between 40 and 100 acres. The fire frequency interval has not been established for the warm riparian forest potential vegetation group, although recent research indicates that the return interval in riparian areas is very similar to the adjacent uplands (Olson 2000). Interior Columbia Basin Ecosystem Management Project findings documented in the Status for the Interior Columbia Basin Summary of Scientific Findings (USDA Forest Service 1996) and Quigley et al. (1997) show that fire exclusion has resulted in declines in aspen communities within the Interior Columbia Basin. Cordilleran sedge (*Carex cordillerana*) is believed to have declined in distribution and abundance through decades of fire suppression, resulting in increased growth of competing understory plants, such as snowberry, that compete for light, water, and nutrients (Carex Working Group 2008). Livestock grazing is believed to have impacted this palatable plant (Wilson et al. 2008).

Table 353. Aspen and cottonwood habitat group description for each species

Scientific Name	Habitat Description	Malheur	Umatilla	Wallowa-Whitman
Carex cordillerana	Naturally disturbed rocky slopes with organic layer and leaf litter in mesic mixed forests, or disturbed, open grassy slopes; 500-2,400 meters. Moist, shady woods; warm-moist plant associations. Found in aspen being taken over by Douglas-fir in Washington.	D	D	D
Tortula mucronifolia	Forms a soil crust.	S	S	S

D: documented within the national forest, S: suspected to occur within the national forest.

Aspen and Cottonwood – Environmental Consequences

Indirect Effects

The Forest Plan objective for this special habitat (1.13) for all three National Forests in the Plan Area is to increase the distribution of aspen and cottonwood as well as increase the young, or sprout, age class of these communities. Increasing the distribution of aspen and cottonwood would benefit other species dependent on the habitat provided by these hardwood tree species, including Cordilleran sedge and mucronleaf tortula moss (*Tortula mucronifolia*). Increasing the amount of young age classes of aspen and cottonwood within existing groves would help in the longer term maintenance of these habitats, which would also benefit dependent species. This may be accomplished by thinning competing coniferous trees, which have the potential to impact both Cordilleran sedge and mucronleaf tortula moss; however, this prescription would benefit the species in the long term. A thinning prescription in this habitat group would benefit the species by increasing solar radiation. Prescribed fire used to reduce fuel loads would benefit the species by helping to reduce competing vegetation. Prescribed fire is expected to benefit Cordilleran sedge in the long term. Plan objectives to move stands in the dry and moist potential vegetation groups toward condition classes 1 and 2 would improve habitat condition for this habitat group, particularly for aspen, which is often found in smaller patches within a larger matrix of dry or moist forest or moist upland shrubland. Alternatives D and E are projected to treat the most acres (215,000 and 220,000 acres respectively) and thereby improve the most aspen habitat compared to the other alternatives. Alternative C projects to treat the fewest acres (155,000 acres), while projections for Alternatives A and F are in the middle (170,000 and 190,000 acres). Thinning conifers and reducing fuels via prescribed fires in aspen stands may make this habitat more accessible and likely more appealing to livestock.

Additional mitigation measures would be applied at the site-specific project level for Alternatives B, E, E-Modified, E-Modified Departure, and F. Under Alternatives B, E and F, tree thinning and fuels reductions used to carry out these objectives would comply with guidelines PL-TES-6 and PL-TES-7 that require sensitive plants to be buffered (minimum 100 feet) from timber harvest and the piling and burning of slash. These guidelines insure that sensitive plants would be avoided by ground disturbing actions and the high, potentially mortal, temperatures that may result from burning concentrations of slash and fuels. Some individual plants may be impacted by subsequent project actions, but these guidelines are expected to maintain populations of sensitive plants, which may later expand their populations into improved habitat. Alternatives E-Modified and E-Modified Departure provide modified standards and guidelines for sensitive plants. Populations of sensitive plants would be avoided by project actions (FLS-6S, FLS-7G) unless the silviculture or fuels and burn prescription would benefit the species. Buffer widths, where needed

to protect sensitive plants, would be determined during project planning. Though some individual plants may be impacted by subsequent project actions, these guidelines would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species in the Plan Area.

Alternatives C and D have no standards and guidelines specific to sensitive plants. Alternative C, having a relatively low predicted annual timber harvest (41 million board feet among the three National Forests) and least amount of livestock grazing (approximately 96,000 AUMs), would have fewer impacts compared to Alternative D, which projects the greatest amount of annual timber harvest (353 million board feet) and livestock grazing (162,145 AUMs). Without additional standards and guidelines to conserve sensitive plants under Alternative D, sensitive plants inhabiting the conifer forest habitat group may be impacted to the degree that the action may contribute a loss of viability to the populations in the Plan Area. With Alternative C, impacts are harder to predict, but upland forage utilization would be capped at 30 percent, same as for Alternatives B, E-Modified, E-Modified Departure, and F. Under Alternative D, upland utilization would range from 45-50 percent depending upon departure from the desired condition. This utilization level may not sustain sensitive plant populations or their understory habitat. (See below for the discussion of effects to sensitive plants in the grassland habitat group.) The effects of Alternative D plan components for livestock grazing within this habitat group are the same as described below for the alternatives under the grasslands habitat group.

Biological Evaluation Finding for Alternative D

Under Alternative D sensitive plants in aspen and cottonwood habitat group or their habitat may be impacted with a consequence that the action will impact individuals or habitat with a consequence that the action may contribute to a trend towards federal listing or cause a loss of viability to the population or species.

Biological Evaluation Finding for Alternative C

Alternative C has the smallest amount of projected activity levels, and though it lacks specific standards and guidelines to conserve sensitive plants, Alternative C would impact individuals or habitat, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species in the Plan Area. This is because of the low likelihood of management actions overlapping occupied habitat and having a grazing utilization standard equivalent to the guideline for sensitive plants that applies to other plan revision alternatives (except Alternative D).

Biological Evaluation Finding for Alternatives A, B, E, E-Modified, E-Modified Departure, and F

Alternatives A, B, E-Modified, E-Modified Departure, and F may impact individuals or habitat, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.

Sagebrush Shrubland – Affected Environment

Sagebrush shrublands are sagebrush communities with at least five percent crown cover of sagebrush (*Artemisia tridentata* or *A. arbuscula*). Stiff sagebrush, *Artemisia rigida*, communities are included under the habitat group lithosol. Species that depend on sagebrush communities are listed in the table below. Both high elevation (cold shrubland potential vegetation group) and lower elevation big sagebrush (moist shrubland potential vegetation group) and low sagebrush -

Artemisia arbuscula (dry shrubland potential vegetation group) communities are included. Both the cold and moist shrubland potential vegetation groups include mountain big sagebrush, *A. tridentata* var. *vaseyana*; however, the understory changes from western needlegrass or elk sedge present in the cold shrubland potential vegetation group to Idaho fescue in the moist shrubland potential vegetation group. Low sagebrush-Idaho fescue communities are also a component of the moist shrubland potential vegetation group.

State and transition modeling (Stringham et al. 2003) was used to classify plant communities assigned to the shrubland and grassland potential vegetation groups in the Plan Area. Johnson and Swanson (2005) apply the state and transition concept to classify vegetation along a gradient of increasing departure from pristine, native vegetation or reference conditions to highly departed or altered plant communities. Phases A to C describe plant communities in a state close to reference, which represents the historic range of vegetation dynamics of a site. Phase A is the most resilient plant community within that state and depicts reference conditions. Phase B shows moderate departure from reference conditions. Phase C is strongly departed from reference conditions and is considered an at-risk phase that is least resilient and most vulnerable to transition to an alternate state, but is able to transition to phases A and B. Sites with vegetation conditions completely departed from reference are classified as Phase D. Transitions to alternate states can be caused by grazing, alteration of water tables through mining or irrigation, cultivation, fire suppression and other large disturbances. A more comprehensive discussion of state and transition concept and its application to vegetation phases is in Volume 1, Chapter 3, “Issue 3: Livestock Grazing and Grazing Land Vegetation.”

Countryman (2010) evaluated continuous vegetation survey plot data and assigned the relative amount of the moist and dry upland shrubland potential vegetation groups to phases A, B, C or D. Results are presented in the tables below. No data were available for the cold upland shrubland potential vegetation groups.

Table 354. Moist upland shrubland potential vegetation group phase existing conditions

Moist Upland Shrubland	Phase A or B	Phase C	Phase D
Malheur	38%	45%	17%
Umatilla	37.5%	12.5%	50%
Wallowa-Whitman	20%	15%	55%

Table 355. Dry upland shrubland potential vegetation group phase existing conditions

Dry Upland Shrubland	Phase A or B	Phase C	Phase D
Malheur	28%	23%	49%
Umatilla	86%	14%	0%
Wallowa-Whitman	8%	23%	69%

The desired condition for shrubland (and grasslands) is that the distribution and abundance of vegetation structural stages, including vegetation density, create conditions that are ecologically resilient, sustainable, and compatible with maintaining disturbance processes; shrubland and grassland communities are able to reproduce and persist on the landscape. These desired conditions describe communities categorized as phases A, B, or C, depicted above. On the Malheur National Forest, where most of the upland shrublands are found in the Blue Mountains, 83 percent of moist upland shrublands and 51 percent of dry upland shrublands are in phases A, B

or C. On the Umatilla National Forest, 50 percent of moist upland shrublands and 100 percent of dry upland shrublands are in phases A, B or C. On the Wallowa-Whitman National Forest 35 percent of moist upland shrublands and 31 percent of dry upland shrublands are classified as phase A, B or C.

Table 356. Sagebrush shrubland habitat group description for each species

Scientific Name	Habitat Description	Malheur	Umatilla	Wallowa-Whitman
Astragalus tegetarioides	Sagebrush flats on volcanic ash or basaltic substrates, adjacent and sometimes encroaching on ponderosa pine forest, cracks of welded tuff outcrops. Moist shrubland potential vegetation group.	D	A	A
Camissonia pygmaea	Unstable soils or gravel in steep talus, dry washes, banks, and roadcuts. Open, bare ground. Moist or Dry Shrubland potential vegetation group.	S	S	S
Castilleja flava var. *rustica*	Talus, open dry hillsides, often with mtn. big sage. Wet, subalpine prairies, limestone cliffs, dry basalt soil, granite cliffs. Mixed conifer forest and open mtn. sage steppe. Cold shrubland potential vegetation group.	S	D	D
Cistanthe rosea	Alkaline soils in moist areas and occasionally in wetlands. In Washington it grows in very dry shrub steppe, in low swales in dark, sandy soil.	D	A	A
Eriogonum salicornioides	Sparsely vegetated, open, ash deposits and clayey substrates; with saltbush, greasewood, sagebrush.	S	A	A
Lupinus cusickii var. *cusickii*	Ashy, sandy soils in sagebrush steppe.	S	A	A
Stanleya confertiflora	Flats and slopes at lower elevations in sagebrush steppe.	S	A	A

D: documented within the national forest, S: suspected to occur within the national forest; A: absent.

Astragalus tegetariodes only occurs within the Malheur National Forest in the mountain big sage sagebrush habitat of the moist upland shrubland potential vegetation group. The state or phase condition of the shrublands within the smaller range occupied by *Astragalus tegetarioides* is not known, but the overall condition of the moist upland shrubland is modest with 38 percent in good condition and 45 percent in fair condition (phase C), capable of recovery to phase B. *Astragalus tegetariodes*, like many members of the milkvetch genus, responds favorably to disturbance regimes, so it is possible this species could be adequately maintained in phase C shrublands. Site observations indicate the species has increased its cover in disturbed areas left to recover, such as double track, jeep trail roads or the margins along unimproved roads. Management activities that may impact *A. tegetariodes* include timber harvest and associated activities (when conducted adjacent to occupied shrublands), livestock grazing, and prescribed fire.

Camissonia pygmaea is suspected to occur but has not yet been discovered on National Forest System lands. Its habitat is believed to occur in the dry upland shrubland potential vegetation group. *Castilleja flava* var. *rustica* occurs in one population in the Elkhorn Mountains within the Wallowa-Whitman National Forest and in four populations within the Umatilla National Forest. Its habitat would be included the cold upland shrubland potential vegetation group.

Sagebrush Shrubland – Environmental Consequences

Indirect Effects Alternatives A, B, E and F

The three species documented on the Plan Area, *Astragalus tegetariodes*, *Camissonia pygmaea* and *Castilleja flava var. rustica* may benefit from Forest Plan objective 1.7, proposed under Alternatives E and F, that would improve rangeland vegetation in phases C and D to phase A or B.

For *A. tegetarioides*, the range of this plant within the Malheur National Forest, for all alternatives, would be allocated to MA 4A General Forest, where all uses would be considered generally suitable. Plan objectives to move stands in the dry and moist potential vegetation groups toward condition classes 1 and 2 may improve *A. tegetariodes* habitat in areas immediately adjacent to timbered stands. Effects to the species would be similar to those described above for *Carex cordillerana*. Thinning pine stands that have encroached habitat for *A. tegetariodes* would be beneficial as a result of modest soil (surface) disturbance and increased solar radiation. Objectives to improve rangeland from phases C and D to phases A and B would assist in moving this habitat type toward the desired conditions of adequate quality, distribution, and abundance for sensitive plants.

The maintenance of *Camissonia pygmaea* (if discovered in the Plan Area) and *Castilleja flava* var. *rustica*, would rely on plan guidelines FLS-3S, FLS-4G, FLS-5G, FLS-6S, FLS-7G, FLS-8G, FLS-9S, FLS-11S, FLS-14G, and LH-4G under Alternatives B, E, and F. These guidelines would require site-specific projects to provide avoidance buffers and would require that grazing management practices be designed to reduce impacts on occupied habitat. Although some individual plants may be impacted, the guidelines are expected to maintain populations of sensitive plants.

Effects from Alternative C

Alternative C would provide the greatest opportunity to achieve the desired condition for sensitive plants in sagebrush steppe. There would be a beneficial effect achieved through the combination of significant reductions in animal unit months (by 75 to 80 percent) and the reduction in acres designated suitable for grazing (by about 65 percent). As a result of these reductions, sensitive species impacted by grazing, even at levels that would sustain their populations, would benefit. Compared to the other alternatives, the desired condition, that the natural range of habitats of plant species is of adequate quality, distribution, and abundance to contribute to maintaining native and desired nonnative species diversity, would be more easily achieved for Alternative C when compared to the other alternatives.

Effects from Alternative D

The combined cattle animal unit months for the Malheur and Wallowa-Whitman National Forests would increase from 212,000 to 259,000 (22 percent) for Alternative D. For the Umatilla National Forest, cattle AUMs would increase from 40,000 to 52,000 (30 percent). These increases combined with grazing at moderate intensities (defined by Holechek (2006) as 41 to 50 percent) is less likely to provide suitable conditions for sensitive plants dependent upon grassland habitat than Alternatives B, C, E, and F. At utilization levels of 45 and 50 percent for Alternative D, desired conditions for grasses within sagebrush steppe may not be achieved. At best, existing conditions might be maintained but the increase in animal unit months would likely impact sensitive species dependent upon grassland habitat. Although past utilization in rangelands under the 1990 Forest Plans have not exceeded 40 percent in most active allotments, this is not a likely

outcome compared to other alternatives given the increases in animal unit months for Alternative D, particularly for the Wallowa-Whitman National Forest (44 percent increase and the Umatilla National Forest (21 percent increase). Sagebrush steppe sensitive plant habitat is not expected to be maintained for Alternative D, and desired conditions for sensitive plants are not expected to be achieved. For Alternative D, individual plants or their habitat may be impacted with a consequence that the action may contribute to a trend towards Federal listing or cause a loss of viability to the population or species in the grasslands habitat group.

Effects from E-Modified and E-Modified Departure

The effects of these alternatives are similar to the effects of Alternative E except that animal unit months increase approximately six percent from Alternative E. The same 30 percent utilization standard applies to occupied sensitive plant habitat. The small increase in animal unit months is not expected to result in effects substantially different from those described for Alternative E.

Biological Evaluation Finding for All Alternatives A, B, C, E, E-Modified, E-Modified Departure, and F

Although some individual plants may be impacted, the guidelines for sensitive plants are expected to maintain populations of sensitive plants. These alternatives do not vary in the biological evaluation finding: may impact individuals or habitat, but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.

Biological Evaluation Finding for Alternative D

Alternative D will impact individuals or habitat with a consequence that the action may contribute to a trend towards federal listing or cause a loss of viability to the population or species for sensitive plants in the grassland habitat group.

Grasslands – Affected Environment

Grasslands are composed of upland herbaceous vegetation dominated by grasses. Meadows and grass or grass-like dominated riparian areas belong to different habitat groups. The sensitive species listed in Table 357 occur in grasslands within the Umatilla and Wallowa-Whitman National Forests. These species occupy moist upland herbland and dry upland herbland potential vegetation groups as described in the “Forest Vegetation” section.

As discussed above under the sagebrush shrubland habitat group, state and transition modeling (Stringham et al. 2003) was also used to classify plant communities assigned to the grassland (or herbland) potential vegetation groups in the Plan Area. Johnson and Swanson (2005) apply the state and transition concept to classify vegetation along a gradient of increasing departure from pristine, native vegetation or reference conditions. Phases A to C describe plant communities in a state close to reference, which represents the historic range of vegetation dynamics of a site. Phase A is the most resilient plant community within that state and depicts reference conditions. Phase B shows moderate departure from reference conditions. Phase C is strongly departed from reference conditions and is considered an at-risk phase that is least resilient and most vulnerable to transition to an alternate state, but is able to transition to phases A and B. Sites with vegetation conditions completely departed from reference are classified as Phase D. Transitions to alternate states can be caused by grazing, alteration of water tables through mining or irrigation, cultivation, fire suppression and other large disturbances. A more comprehensive discussion of state and transition concept and its application to vegetation phases is in the “Issue 3: Livestock Grazing and Grazing Land Vegetation” section of Volume 1.

Table 357. Grasslands habitat group description for each species

Scientific Name	Habitat Description	Malheur	Umatilla	Wallowa-Whitman
Allium campanulatum	Rocky ridges of grasslands.	A	D	A
Allium dictuon	Rocky ridges of grasslands.	A	D	A
Astragalus arthurii	Bunchgrass communities, mostly low elevation Idaho fescue-prairie junegrass sites; sumac and bluebunch wheatgrass, Idaho fescue- bluebunch wheatgrass/balsamroot; bluebunch-poa secunda.	A	D	D
Astragalus cusickii var. *cusickii*	Dry, grassy or rocky slopes; in loose, finely textured soils derived from basalt, on basalt cliffs and talus; w/bluebunch wheatgrass and Idaho fescue.	A	D	D
Calochortus nitidus	Idaho fescue – prairie junegrass grasslands; typically ridges and shoulders; currently not known from Oregon	A	A	S
Calochortus macrocarpus var. *maculosus*	Dry plains, rocky slopes, sagebrush scrub, pine forests, usually in volcanic soil; 300-2,700 meters. Dry grasslands, ridgetops. In rocky, basaltic derived soils, on hillsides, rock outcrops and cliff bands. In grasslands on steep slopes.	A	D	D
Delphinium bicolor	Low larkspur is found on sites ranging from open woods and grasslands. Low larkspur is found on sites ranging from open woods and grasslands to subalpine scree.	A	D	D
Lomatium rollinsii	Canyon grasslands; slopes: very steep to relatively gentle; soils: gravelly and rocky to deeper loamy conditions. Associated species include Idaho fescue (*Festuca idahoensis*), bluebunch wheatgrass (*Agropyron spicatum*), and Sandberg's bluegrass (*Poa sandbergii*).	A	D	D
Pyrrocoma scaberula	FEID-AGSP-KOMA; Snowberry (Symphoricarpos albus), and native roses (*Rosa woodsii* and *R. nutkana*) are the most common shrub associates, but serviceberry (*Amelanchier alnifolia*), Oregon grape (*Mahonia repens*) and others can also co-occur.	A	S	D

D: documented within the national forest, S: suspected to occur

Countryman (2010) evaluated continuous vegetation survey plot data and calculated the relative amount of the moist and dry upland grassland potential vegetation groups to phases A, B, C or D. Results are presented in Table 358 and Table 359.

The desired condition for grasslands is that the distribution and abundance of vegetation structural stages, including vegetation density are ecologically resilient, sustainable, and compatible with maintaining disturbance processes; grassland communities are able to reproduce

and persist on the landscape. These desired conditions describe communities categorized as phases A, B, or C, depicted above.

Table 358. Moist upland grassland potential vegetation group phase existing conditions

Moist Upland Grassland	Phase A or B	Phase C	Phase D
Malheur	91%	9%	0%
Umatilla	50%	37.5%	12.5%
Wallowa-Whitman	67%	17%	16%

Table 359. Dry upland grassland potential vegetation group phase existing conditions

Dry Upland Grassland	Phase A or B	Phase C	Phase D
Malheur	21	43	36
Umatilla	42	35.5	22.5
Wallowa-Whitman	46.5	32	21.5

Improper heavy grazing, unnaturally high fire frequency, and invasion by exotic plants are the biggest threats to the sensitive species occupying grassland habitat. Higher fire frequencies are to be expected in phases C and D grasslands, which have a higher proportion of nonnative invasive species at the expense of native bunchgrasses. Therefore, actions to promote the transition of phase C grasslands to phase A or B would best address the threats from invasive plants and high fire frequencies.

Grasslands – Environmental Consequences

Indirect Effects

The alternatives include objectives to increase the proportion of phase A or B grasslands, which would benefit sensitive plants that inhabit grasslands. Where alternatives vary is in utilization (i.e., forage consumption) standards for upland vegetation and permitted animal unit months. Upland vegetation maximum utilization standards and guidelines are displayed in Table 360 for management systems that incorporate deferment, rest, and rotation, which comprise the vast majority of grazing allotments in the Blue Mountains national forests. Season long grazing systems are displayed in Table 361, although this system is rarely applied on grazing allotments in the National Forests of the Blue Mountains.

Holechek (2006) reviewed grazing studies that compared controlled intensity, timing, and frequency with grazing exclusion and concluded that grazing is sustainable and could be beneficial compared to complete exclusion when grazing intensities do not exceed 40 percent utilization. Miller et al. (1994) found that communities capable of returning to good ecological condition could occur either under grazing exclusion or at light to moderate grazing intensity. Miller did not quantify utilization at either light or moderate grazing levels, but Holechek (2006) defines these levels quantitatively and qualitatively: non-use to light grazing ranges from zero to 30 percent utilization and moderate grazing from 41 to 50 percent utilization. Holechek further defined utilization from 31 and 40 percent as conservative and heavy grazing for utilization levels exceeding 50 percent. The discussion of indirect effects summarizes the findings of effects to grazing land ecological phases. A fuller discussion of how utilization levels affect rangeland vegetation is located in the Livestock Grazing and Rangeland Vegetation section.

Table 360. Upland vegetation percent maximum utilization standards and guidelines for management systems that incorporate deferment, rest, and rotation.

Departure from Desired Condition	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E, E-Modified, E-Modified Departure	Alt. F
Low departure	50-60	55	30	50	40	40
Moderate or greater departure	50	35	30	45	35	35

Table 361. Upland vegetation percent maximum utilization standards and guidelines for season long management systems.

Departure from Desired Condition	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E, E-Modified, E-Modified Departure	Alt. F
Low departure	50-60	50	30	45	35	35
Moderate or greater departure	50	30	30	40	30	30

Effects Common to All Alternatives except Alternative A

The plan objectives to reduce current infestations of invasive plant species would assist in increasing the amount of phases A and B grasslands and consequently would benefit sensitive species.

Effects from Alternative A (no action)

The relative amount of rangeland in phases A through D is expected to remain similar to the existing condition. No improvements from phase C are expected. Sensitive plant species inhabiting grasslands would have the fewest acres of suitable habitat in phase A or B. The desired condition of a minimum 70 percent of grasslands in phase A or B would not be met.

Effects from Alternative B

Areas moderately or greatly departed from the desired condition would be grazed at lower intensity, not to exceed 35 percent utilization, to allow improvement of rangeland condition and movement toward the desired condition. These kinds of improvements in condition should benefit sensitive species inhabiting upland grasslands. For areas with low departure from the desired condition, grazing at 55 percent maximum utilization, a level considered heavy by Holechek (2006), could lead to a decline in phases A and B communities. This utilization level would likely move these communities further from the desired condition, although it has been reported that the observed actual past use in upland rangelands has not exceeded 40 percent under the 1990 Forest Plans (Alternative A) permitted use of up to 60 percent (see the “Livestock Grazing and Rangeland Vegetation” section). If utilization levels exceed 50 percent on large expanses of grasslands, declines in suitable habitat for grassland dependent sensitive species would be expected. Forest plan guideline FLS-3S would limit forage utilization on key species in occupied habitat to 30 percent or less. This level is expected to maintain sensitive plants in grasslands.

Effects from Alternative C

Alternative C would provide the greatest opportunity to achieve the desired condition for sensitive plants in grasslands. There would be a beneficial affect achieved through a combination

of significant reductions in animal unit months (by 75 to 80 percent) and in the acres designated suitable for grazing (by about 65 percent). As a result of the reductions, sensitive species impacted by grazing, even at levels that would sustain their populations, would benefit. Compared to the other alternatives, the desired condition, that the natural range of habitats of plant species is of adequate quality, distribution, and abundance to contribute to maintaining native and desired nonnative species diversity, would be more easily achieved for Alternative C.

Effects from Alternative D

The combined cattle animal unit months for the Malheur and Wallowa-Whitman National Forests would increase 22 percent for Alternative D. For the Umatilla National Forest, cattle AUMs would increase from 30 percent. These increases when combined with grazing at moderate intensities (defined by Holechek (2006) as 41 to 50 percent) are less likely to provide suitable conditions for sensitive plants dependent upon grassland habitat compared to Alternatives B, C, E, and F. At utilization levels of 45 and 50 percent for Alternative D, desired conditions for grasslands may not be achieved. For the dry or moist upland grasslands, the existing condition of 50 percent or less in phase A or B would need to increase to 70 to 90 percent in phase A or B. At best, existing conditions might be maintained and would likely impact sensitive species dependent upon grassland habitat. Because past utilization in rangelands under the 1990 Forest Plans have not exceeded 40 percent in most active allotments, even when utilization levels up to 60 percent were authorized, the effects expected for the maximum authorized utilization may not occur. However, given the percent increases in animal unit months under Alternative D, this outcome is less likely compared to Alternative B, particularly for the Wallowa-Whitman National Forest (with a 44 percent increase in animal unit months) and the Umatilla National Forest (21 percent increase in animal unit months). Grassland sensitive plant habitat is not expected to be maintained for Alternative D, and desired conditions for sensitive plants are not expected to be achieved. For the sensitive plants occupying the grasslands habitat group, Alternative D is likely to impact individuals or habitat with a consequence that the action may contribute to a trend towards federal listing or cause a loss of viability to the population or species.

Effects from Alternatives E and F

Alternatives E and F would reduce upland forage utilization to 40 percent for uplands exhibiting low departure from desired conditions and 35 percent for uplands exhibiting moderately or greater departure while holding cattle animal unit months constant and slightly decreasing sheep animal unit months. These changes from the existing plan levels would improve the condition of grasslands. The addition of guideline FLS-3S that would limit utilization to not more than 30 percent on key forage species in occupied habitat would further contribute to maintaining sensitive plant species that inhabit grasslands. Alternatives E and F would achieve desired conditions for sensitive plants at a faster rate than Alternatives A and B, E-Modified and E-Modified Departure but not as quickly as Alternative C.

Effects from Alternatives E-Modified and E-Modified Departure

The effects of these alternatives are similar to the effects of Alternative E except that animal unit months increase approximately six percent from Alternative E. Guideline FLS-4G limits to 30 percent utilization of key forage species in occupied sensitive plant habitat. A small increase in animal unit months is not expected to result in effects substantially different from those described under Alternative E.

Biological Evaluation Finding for All Alternatives A, B, C, E, E-Modified, E-Modified Departure, and F

Although some individual plants may be impacted, the guidelines are expected to maintain populations of sensitive plants. These alternatives do not vary in the biological evaluation finding: may impact individuals or habitat, but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.

Biological Evaluation Finding for Alternative D

Sensitive plants in the grassland habitat group may be impacted with a consequence that the action may cause a loss of viability in the Plan Area.

Basalt Lithosols – Affected Environment

Lithosols are habitats with very shallow soils with little zonation on poorly weathered basalt or andesitic bedrock. Soils on basalt lithosols are often saturated following spring snow melt but dry quickly when exposed to full sun for the entire growing season. Plants adapted to this harsh environment usually bloom and fruit earlier in the growing season. Basalt lithosols can be found in the dry upland shrubland potential vegetation group or dry upland herbland potential vegetation group. Basalt lithosols may also be found as small inclusions within a larger matrix of grassland and shrublands. The common plant associations within the dry upland shrubland and dry upland grassland potential vegetation groupings are stiff sagebrush/Sandberg's bluegrass, low sagebrush/Sandberg's bluegrass, bluebunch wheatgrass/Sandberg's bluegrass and Sandberg's bluegrass/one-spike oatgrass. Countryman and Swanson (2008) found that conditions had improved in the dry shrubland potential vegetation group from 30 years earlier, but that this improvement has slowed. The relative percentages of dry upland shrublands and dry upland grasslands are summarized in the following tables.

Table 362. Dry upland shrubland – percent of potential vegetation group in phases A/B, C or D

Forest	Phase A/B (%)	Phase C (%)	Phase D (%)
Malheur	28	23	49
Umatilla	86	14	0
Wallowa-Whitman	7	23	69

Table 363. Dry upland grassland – percent of potential vegetation group in phases A/B, C or D

Forest	Phase A/B (%)	Phase C (%)	Phase D (%)
Malheur	21	43	36
Umatilla	42	35.5	22.5
Wallowa-Whitman	46	32	22

Active restoration would be required to return phase D to phase A or B, although, given this habitat type's low productivity, successful transition from phase D to phase A or B may not be possible.

Heavy grazing, spring grazing when soils are moist, and invasion by exotic plants are the main threats to basalt lithosol habitats. Given the low productivity and discontinuous fuels in this habitat group, effects from fire are not considered a major threat. The dry grassland potential vegetation group has experienced invasion by nonnative plants resulting in conversion of some

lands to exotic grasslands (Hann et al. 1997). Plants inhabiting basalt lithosols are listed in Table 364.

Table 364. Basalt lithosol habitat group description for each species

Scientific Name	Habitat Description	Malheur	Umatilla	Wallowa-Whitman
Achnatherum wallowaensis	Basalt scablands and lithosols; shallow rocky soils, sometimes with stiff sage, strict buckwheat, and ponderosa pine surrounding.	S	S	D
Achnatherum hendersonii	Basalt scablands and lithosols; shallow rocky soils, sometimes with stiff sage, strict buckwheat; often surrounded by ponderosa pine.	S	S	S
Artemisia arbuscula ssp. longicaulis	Sagebrush steppe, 1,050 – 2,000 meters. Distribution is Basin and Range.	S	A	A
Chaenactis xantiana	Barren, sandy soils	S	A	A
Erigeron disparipilus	Gravelly and rocky slopes, ridges, sagebrush, grassland. Basalt scablands, lithosols, dry ridges in ne Oregon. Often with stiff sage.	A	D	D
Erigeron engelmannii var. *davisii*	Bare, rocky ridges and slopes, basalt outcrops, sparsely vegetated woodland openings or edges; usually with grasses 1,200-1,800 meters.	A	A	D
Erigeron engelmannii var. *davisii*	Bare, rocky ridges and slopes, basalt outcrops, sparsely vegetated woodland openings or edges; usually with grasses 1,200-1,800 meters.	A	A	D
Eriogonum cusickii	Barren flats and hills with dry soil over weathered basalt or welded tuff	S	A	A
Lomatium ravenii	Scablands, lithosols. Openings in mixed or ponderosa pine forests. Flats, slopes, or ridges. Often with stiff sage, in openings in juniper or pine woodlands. Moderate elevations.	D	S	S

D: documented within the national forest, S: suspected to occur within the national forest; A: absent.

Basalt Lithosol – Environmental Consequences

Indirect Effects of Alternatives B, E and F

Spring grazing could impact the species occupying lithosol habitats. During spring the soils are wet and susceptible to compaction from livestock. Guideline PL-TES-4, limiting utilization to not more than 30 percent on key species would help reduce impacts to sensitive plants inhabiting basalt lithosols. Given the low productivity on the site, 30 percent utilization would equate to a comparatively short period. Corresponding trampling associated with grazing is expected to be light. Guideline PL-TES-5, excluding water developments and salting within one-quarter mile of sensitive plant locations, would help reduce concentrations of livestock near occupied habitat. Reduced use and trampling by livestock would help abate invasion by nonnative plants, especially exotic annual grasses, such as cheatgrass and North Africa grass.

Effects from Alternative C

Alternative C would provide the greatest opportunity to achieve the desired condition for sensitive plants inhabiting basalt lithosols. There would be a beneficial affect achieved through a combination of significant reductions in animal unit months (by 75 to 80 percent) and in the acres designated suitable for grazing (by about 65 percent). As a result of the reductions, sensitive species impacted by grazing, even at levels that would sustain their populations, would benefit. Compared to the other alternatives, the desired condition, that the natural range of habitats of plant species is of adequate quality, distribution, and abundance to contribute to maintaining native and desired nonnative species diversity, would be more easily achieved for Alternative C.

Effects from Alternative D

Alternative D, having significantly more animal unit months and higher levels of upland utilization levels (45-50 percent) would likely result in a greater degree of trampling and herbivory to the basalt lithosol habitats. Under Alternative D, the combined cattle animal unit months for the Malheur and Wallowa-Whitman National Forests would increase from 212,000 to 259,000 (22 percent). For the Umatilla National Forest, cattle animal unit months would increase from 40,000 to 52,000 (30 percent). These increases in animal unit months combined with grazing at a greater utilization levels of 45 to 50 percent are less likely to provide suitable conditions for sensitive plants dependent upon lithosol habitat.

Effects from Alternative E-Modified and E-Modified Departure

The effects of these alternatives are similar to the effects of Alternative E except that AUMs increase approximately six percent from Alternative E. The same 30 percent utilization standard applies to occupied sensitive plant habitat. The small increase in animal unit months is not expected to result in effects substantially different from those described for Alternative E.

Biological Evaluation Finding for Alternative D

Sensitive plants in the basalt lithosol habitat group may be impacted with a consequence that the action may cause a loss of viability in the Plan Area.

Biological Evaluation Finding for all Alternatives A, B, C, D, E, E-Modified, E-Modified Departure and F

Although some individual plants may be impacted, these guidelines are expected to maintain populations of sensitive plants. The plan revision alternatives do not vary in the biological evaluation finding: may impact individuals or habitat, but will not likely contribute to a trend towards Federal listing or cause a loss of viability to the population or species.

Talus, Cliffs, and Rock Outcrops – Affected Environment

Talus is accumulated boulders and cobbles at the base of cliffs or on steep slopes. Because these habitats are largely composed of bedrock and accumulations of rocks, gravels and sands, they are assumed to be in good condition with a stable trend. The nature of this habitat group means it is resistant to management activities or has been avoided with most management activities, with the exception of road construction and rock quarries. Species that occupy talus, cliffs and rock outcrops are listed in Table 365.

Table 365. Talus, cliffs, and rock outcrops habitat group description for each species

Scientific Name	Habitat Description	Malheur	Umatilla	Wallowa-Whitman
Anastrophyllum minutum	Grows on peaty soil at relatively high elevations (greater than 5,500 feet). In the *Tsuga mertensiana* zone, the colonies of *Anastrophyllum minutum* are typically associated with other bryophytes in tight mats on ledges or at the base of cliffs. Wallowa County.	A	A	D
Anthelia julacea	On rock surfaces, wet rock surfaces, and dry soil. In arctic-alpine areas of northern North America. Wallowa County.	A	A	D
Arabis hastatula	Basalt outcrops, cliffs, and scree. Rocky outcrops and mountain ridges.	A	A	D
Asplenium trichomanes-ramosum	Wet, shady, limestone cliffs. Grows in moss and crevices. Basic rocks in talus slopes. Zero-4,000 meters.	A	A	D
Barbilophozia lycopodioides	Organic soil to rock, less often on tree bark. Not necessarily on mineral soil. Reported by Hong (1976), Anthony Lakes area, Baker County. Damp outcrops at higher elevations.	S	S	D
Bolandra oregana	Moist rocky seeps, springs, waterfalls. Grows from wet crevices and moss.	A	D	A
Bryum calobryoides	Forming sods or occurring as individuals among other mosses, on both acid and basic rocks and soil in shaded to exposed boulder fields, montane to alpine meadows, cliffs, and outcrops. Elevations range from 900 to 2,100 meters.	D	A	A
Cheilanthes feei	Rocky outcrops, usually calcareous.	S	S	D
Cryptogramma stelleri	Sheltered calcareous cliff crevices and rock ledges, typically in coniferous or boreal forest; 0-3,000 meters. On wet cliffs, and ledges, along streams, under waterfalls. Limestone substrate. Shady sites. Usually north-facing aspects.	A	A	D
Encalypta brevipes	Soil on ledges and in crevices on cliffs, reported from both igneous and siliceous substrates.	S	S	S
Geum rossii var. turbinatum	Granitic cliffs and ledges, in cirque basins. Talus slopes, rocky ridge tops, and rocky soil. Basalt, granite, or loose granodiorite substrate. Sub-alpine high elevation sites.	A	A	D
Hackelia diffusa var. diffusa	Shaded areas, cliffs, *talus, wooded flats and slopes.* Occurs with *Symphoricarpos albus, Philadelphus lewisii, Osmorhiza occidentalis, Acer glabrum, Fritillaria pudica, and Erysimum occidentale*. Elevation of populations in Washington is around 1,000 feet.	A	D	A
Lophozia gillmanii	Peaty soil on cliff ledges; strict calciphile. Above 6,500 feet.	S	D	D
Luina serpentina	Open, rocky sites with poor soil development. Usually on steep slopes, above small tributaries. Aldrich Mountains.	D	A	A
Pellaea bridgesii	Rocky slopes and cliffs, on granitic substrate; 1,200-3,600 meters. Talus slopes, scree, rocky outcrops; often on argillite in Blue Mountains. Southerly aspects.	S	D	D

Scientific Name	Habitat Description	Malheur	Umatilla	Wallowa-Whitman
Phlox multiflora ssp. depressa	Basalt cliffs, rocky outcrops, rocky openings in dry forest. Wooded rocky areas as well as in openings in the forest. Loose substrate rather than exposed hard rocks.	A	S	D
Rubus bartonianus	Boulder talus, rocky slopes at lower elevations. Endemic and apparently confined to the Snake River canyon in Oregon and Idaho	A	A	D
Suksdorfia violacea	In moss on wet cliffs, cracks of moist talus slopes, on basalt. Habitat sometimes is only wet in the spring.	A	S	S

D: documented within the national forest, S: suspected to occur within the national forest; A: absent.

Talus, Cliffs, and Rock Outcrops – Environmental Consequences

Indirect Effects

Talus, cliffs, and rock outcrops are likely to have relatively small impacts. Outside wilderness areas, this habitat type is likely to be the least affected by forest and rangeland management activities. This is because talus, cliffs, and rock outcrops support scant vegetation that does not support or attract grazing livestock or possess sufficient fuel to carry a prescribed fire. Road construction and rock quarries are likely to be the only management activities with potential to affect these habitats.

Effects of Alternative A

Alternative A has few standards or guidelines directing the management of sensitive plants. Alternative A includes a standard to conduct a biological evaluation for each project to determine the effects to sensitive species. The objectives and standards for biological evaluations are directed by the Forest Service Manual (FSM 2672.4). The Forest Service Manual directs the agency to “review all Forest Service planned, funded, executed, or permitted programs and activities for possible effects on endangered, threatened, proposed, or sensitive species” by conducting a biological evaluation. The biological evaluation is the means of conducting the review and documenting the findings. Forest Service objectives for sensitive species are “to ensure that Forest Service actions do not contribute to a loss of viability of any native or desired nonnative plant or contribute to animal species or trends toward Federal listing of any species” (FSM 2672.41). Therefore, Alternative A may impact individuals or habitat, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.

Effects from Alternatives B, E and F

Impacts associated with road construction activities would be addressed with guideline FLS-9S, which directs that new road construction avoid sensitive plants with a minimum 25-foot buffer. Impacts associated with rock quarries would be addressed with guideline FLS14G, which requires mining operations to avoid sensitive plants to the greatest extent possible. Although some individual plants may be impacted, the guidelines are expected to maintain populations of sensitive plants.

Effects from Alternative C

Alternative C, with fewer levels of activities, especially road construction and associated quarry development, is least likely to impact the talus, cliff, and rock outcrop habitat group. Compared to

the other alternatives, the desired condition, that the natural range of habitats of plant species is of adequate quality, distribution, and abundance to contribute to maintaining native and desired nonnative species diversity, would be more easily achieved under Alternative C for plants in the talus, cliff, and rock outcrop habitat group. Alternative C may impact individuals or habitat, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.

Effects from Alternative D

Alternative D would increase livestock animal unit months and timber harvest level; talus, cliffs and rock outcrop habitats are not likely to be impacted by these activities. These habitats produce no forage and are likely to be avoided by livestock. Similarly, timber harvest and vegetation management would not occur in these habitats. These habitats may be adjacent or even included in vegetation management units and may be indirectly affected by opening the forest canopy and increasing the amount of sunlight. Roads could be constructed through this habitat, impacting the species occupying them, but new road construction that would result from increased vegetation management and timber harvest is not anticipated to be so extensive that significant portions of talus, cliff and rock outcrop habitat would be impacted to the degree that species or population viability in the Plan Area would be compromised.

Alternative D may impact individuals or habitat, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.

Effects from Alternative E-Modified and E-Modified Departure

These effects of Alternatives E-Modified and E-Modified Departure are the same as described for Alternatives B, E and F, except that standards for sensitive plants have been modified. Minimum buffers for road construction (guideline FLS-9S) are not specified, but roads would be designed to minimize adverse impacts to occupied habitat of sensitive plant species.

Alternatives E-Modified and E-Modified Departure do not vary in the biological evaluation finding: may impact individuals or habitat, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.

Aquatic and Riparian Dependent Species Habitats – Affected Environment

Species dependent on aquatic and riparian habitats (aquatic areas, peatlands, seeps and springs, riparian areas, intermittent streams, moist meadows, and wet meadows) are listed in Table 366 to Table 372. Because the Forest Plan manages these habitats under direction for riparian management areas, the effects to species dependent upon these habitats will be addressed together following the tables.

Aquatic Habitats – Affected Environment

Aquatic habitat supports plants that are free-floating or rooted at the bottom of ponds, lakes, streams and rivers. Species that depend on aquatic habitats are displayed in the following table.

Table 366. Aquatic habitat group description for each species

Scientific Name	Habitat Description	Malheur	Umatilla	Wallowa-Whitman
Elatine brachysperma	Plants submerged to terrestrial on muddy shores and shallow pools.	S	D	S
Potamogeton diversifolius	Shallow ponds; edges of reservoirs and small catchment ponds, and shallow, slow running creeks.	S	S	S
Rotala ramosior	Moist sites, drying edges of ponds, springs and streams.	S	S	S
Utricularia minor	Boulders, and rocky substrate in cold water streams; submerged	A	S	A
Utricularia ochroleuca	Ponds, lakes, slow-moving streams.	S	D	S

D: documented within the national forest, S: suspected to occur within the national forest; A: absent.

Peatlands – Affected Environment

Peatlands are a type of wetland that accumulates partially decayed plant matter (peat) (Mitsch and Gosselink 2007, USDA Forest Service 2012). Peat is partially decayed plant material that accumulates under saturated conditions where there is little oxygen to facilitate decomposition (USDA Forest Service 2012). Two major types of peatlands are fen and bog. Fen, the main type of peatland in the Blue Mountains, is fed by groundwater or mineral-rich surface water, has neutral to alkaline pH, and supports relatively rich marsh-like vegetation. Fen is distinguished from marsh, which is a wetland on mineral soil (USDA Forest Service 1998). A bog receives water entirely from precipitation, accumulating sufficient peat to raise the surface layer above the influence of the water table (USDA Forest Service 1998), and is very acidic in pH. Bogs form under a climate where precipitation exceeds evapotranspiration, a condition not present in the Blue Mountains. Bogs are, therefore, not expected to be found in the Blue Mountains, except possibly as hummocky microsites within fens.

Peatlands can be found on each national forest in the Plan Area, but are unique habitats, not common in the Blue Mountains. This is due, in part, to a climate that does not favor their extensive development. Peatlands form stable plant communities that are self-perpetuating in the absence of disturbance. The combination of habitat rarity, stability, and extreme conditions in peatlands engenders a distinctive flora with high concentrations of rare species (Chadde et al. 1998). Sensitive plants that depend on peatland habitat are displayed in the following table.

Table 367. Peatlands habitat group description for each species

Scientific Name	Habitat Description	Malheur	Umatilla	Wallowa-Whitman
Botrychium crenulatum	Local in marshy or springy areas, 1,200-2,500 meters. Moist meadows, riparian zones, moist roadsides, openings in cold forests. Often in calcareous soils, but not necessarily.	D	D	D
Carex diandra	Bogs and fens; floating peat mats, lakeshores, springs, and seeps.	S	S	S

Scientific Name	Habitat Description	Malheur	Umatilla	Wallowa-Whitman
Carex gynocrates	Wet, peaty ground, usually in openings in coniferous swamps and conifer-hardwood stands, less often in poor fens, boggy swales, and alder thickets, also subalpine meadows, tundra, outwash gravel and seepage areas, usually calcareous substrate zero-3,100 meters.	A	A	D
Carex lasiocarpa var. americana	Sedge meadows, fens, bogs, lakeshores, stream banks, usually in very wet sites and sometimes forming floating mats. Dominant of boreal wetlands, often forming huge stands zero-1,300 meters.	S	S	S
Epilobium oreganum	Fens and bogs; affinity for serpentine soils, but not strictly so.	A	S	A
Gentiana prostrata	Alpine bogs and meadows at high elevations.	A	A	S
Harpanthus flotovianus	Bogs and fens. According to Hong (1993), it "occurs on moist humus, soil covered rocks and decaying wood in forests, and is frequently associated with *Cephalozia bicuspidata* and *Scapania undulate*.	S	D	D
Helodium blandowii	Bogs, fens, wet meadows, and stream sides. Shady sites to full sun.	D	D	S
Meesia uliginosa	Fens	D	S	S
Platanthera obtusata	Mesic to wet coniferous forest, forested fens, sphagnum bogs, streambanks, tundra, moist roadsides; zero-3,500 meters. Sometimes found growing on top of rotting logs. Often with Engelmann spruce, or sub-alpine fir.	A	A	D
Pseudocalliergon trifarium	Forming lawns or inconspicuously intermixed with other bryophytes in medium to rich montane fens where it grows submerged to emergent in pools or on saturated ground, usually in full sunlight.	A	A	S
Splachnum ampullaceum	Forming green sods on old dung of herbivores, or on soil enriched by dung, in peat lands or other wetlands.	S	S	S
Tomentypnum nitens	Forming loose or dense sods or intermixed with other bryophytes in medium to rich montane fens where it favors slightly elevated sites, such as logs, stumps, or hummocks, formed by *Vaccinium uliginosum* and *Betula glandulosa*.	D	S	S

D: documented within the national forest, S: suspected to occur within the national forest; A: absent.

Seeps and Springs – Affected Environment

Springs are points where groundwater emerges and flows. Groundwater also feeds seeps, but seeps do not produce perennial flow. Springs and seeps are typically small, but are well distributed on all three forests in the Plan Area. Species that inhabit seeps and springs are displayed in the following table.

Table 368. Seeps and springs habitat group description for each species

Scientific Name	Habitat Description	Malheur	Umatilla	Wallowa-Whitman
Encalypta intermedia	In permanent seep, on thin soil over calcareous rocks. 8-19-1996, D. Wagner. Goodrich Lake, Baker Ranger District.	A	A	D
Entosthodon fascicularis	Occurring as individual plants or forming small sods on seasonally wet, exposed soil in seeps or along intermittent streams.	S	S	S
Jungermannia polaris	In permanent seep, on thin soil over calcareous rocks. 8-19-1996, D. Wagner. Goodrich Lake, Baker Ranger District.	S	A	D
Mimulus hymenophyllus	Springs in low to moderate elevation grasslands	A	A	D
Peltolepis quadrata	In permanent seep, on thin soil over calcareous rocks. 8-19-1996, D. Wagner. Goodrich Lake, Baker Ranger District.	S	A	D
Preissia quadrata	In permanent seep, on thin soil over calcareous rocks. 8-19-1996, D. Wagner. Goodrich Lake, Baker Ranger District.	A	A	D
Thelypodium eucosmum	Under and around western Juniper, in canyons, seasonal creek drainages, and seeps/springs. Also found in vernally moist areas in ponderosa pine forests and in sage steppe areas. Known sites are 1,800-5,000 feet.	D	D	S
Trollius laxus ssp. *Albiflorus*	Open, wet places, more or less acidic soils, montane to alpine; 1,200-3,800 meters. Seeps, springs, and vernally wet swales in spruce/fir forest.	S	S	S

D: documented within the national forest, S: suspected to occur within the national forest; A: absent.

Intermittent Streams – Affected Environment

Species that occupy intermittent stream channels are displayed in the following table.

Table 369. Intermittent streams habitat group description for each species

Scientific Name	Habitat Description	Malheur	Umatilla	Wallowa-Whitman
Mimulus evanescens	Vernally moist sites and fluctuating banks of intermittent streams or pools in sagebrush-juniper zone. Amid heavy gravel and boulders at one site. 1,200-1,700 meters. Historic site on Bear Valley Ranger District.	D (Historical Record)	S	S
Muhlenbergia minutissima	Open, more or less disturbed, sandy, gravelly drainages, rocky slopes, flats, roads.	S	S	S
Schistidium cinclidodonteum	Rocks along watercourses of intermittent and seasonal streams. Union County. Reported for calcareous rocks.	S	S	D

D: documented within the national forest, S: suspected to occur within the national forest.

Riparian Areas – Affected Environment

Riparian areas are the ecotone between rivers or streams and uplands. They are seasonally or perennially moist. Species that inhabit riparian areas are displayed in the following table.

Table 370. Riparian areas habitat group description for each species

Scientific Name	Habitat Description	Malheur	Umatilla	Wallowa-Whitman
Carex capillaris	Mesic to moist tundra, seeps on cliffs, rocks, and slopes, fens, meadows, shores, prairie sloughs, edges of sphagnum mats, moist woods zero-3,500 meters.	A	A	D
Carex crawfordii	Pond margins that are wet in spring and other seasonally wet spots.	S	S	S
Carex media	Forest openings, meadows, bog margins; 100-1,800 meters. Riparian areas, seeps, moist meadows. In WA, is found near perennial streams and ponds, and in moist meadows at elevations of 4,900-7,120 feet.	A	A	D
Carex retrorsa	Swamps, wet thickets, often along streams, marshes, sedge meadows, shores of streams, ponds, and lakes zero-1,900 meters.	S	S	D
Carex saxatilis	Lake shores, fens, bogs at high elevations.	A	A	D
Carex scirpoidea ssp. stenochlaena	Wet areas along streams, meadows and wet, springy seeps	D	A	A
Cyperus lupulinus ssp. lupulinus	Sandy soil along low elevations rivers and streams	A	S	D
Juncus triglumis var. albescens	Stream, lake margins at high elevations usually on calcareous substrate	A	A	D
Lipocarpha aristulata	Wet soil and mud, often comprised of fine sand and silt, in bottomlands, sandbars, beaches, shorelines, stream banks, ponds, and ditches. At low elevations.	A	S	D
Lycopodium complanatum	Dry open coniferous or mixed forest alpine slopes; zero-2,000 meters. Coniferous forest, with thick duff. Often on rotting logs, moist forest, riparian areas. Also in meadows and on open ridgetops.	S	S	D
Ptilidium pulcherrimum	Perennially moist tree bases, rotten logs, and on rocks. Baker County.	S	A	D
Ribes oxyacanthoides ssp. Irriguum	Riparian conifer forest: PIPO-PSME; associated with *Amelenchier alnifolia, Crataegus douglasii, Ribes cereum, Symphoricarpos albus*.	A	D	A
Rorippa columbiae	Near all types of bodies of water, including along the Columbia River, intermittent snow-fed streams, permanent lakes, snow-fed lakes, wet meadows, irrigation ditches, and roadside ditches. Sandy soils.	S	D	S
Schistostega pennata	Mineral soil in crevices and sheltered portions on underside of rootwads of fallen trees.	S	S	S
Tetraphis geniculata	On cut or broken ends or lower sides of logs, decay class III-V, greater than 15 inches.	S	S	S
Trifolium douglasii	Moist or mesic meadows, prairie remnants, along riparian areas along streams. In swales, along intermittent streams, and in vernally wet areas.	A	D	D

D: documented within the national forest, S: suspected to occur within the national forest; A: absent.

Moist Meadows – Affected Environment

Moist meadows are typically saturated in the spring, but by mid to late summer the water table has fallen below the soil surface. Species that inhabit moist meadows are displayed in the following table.

Table 371. Moist meadows habitat group description for each species

Scientific Name	Habitat Description	Malheur	Umatilla	Wallowa-Whitman
Allium geyeri var. geyeri	Moist meadows along streams. Known currently from the Hells Canyon NRA; possibly occurring in similar habitat in northern Blue Mountains.	A	A	D
Botrychium campestre	Prairies, dunes, grassy railroad sidings, and fields over limestone. 50-1,200 meters. Moist meadows, riparian zones, roadsides, openings in cold forests. Occurs in dry to mesic, sunlit habitats, often on till or moraines. Does not need direct sunlight.	A	S	D
Botrychium hesperium	Grassy mtn. slopes, snow fields, and road ditches, w/willows, and sand dunes, 200-2,800 meters. Moist meadows, riparian, moist roadsides, openings and edges of forests. Often on calcareous soils. Sometimes found in roadside ditches and at edges of lakes.	S	D	D
Botrychium lineare	Moist meadows, riparian zones, moist roadsides, openings and edges of cold forests. Sometimes in limestone, but not always.	S	S	D
Botrychium lunaria	Open fields, occasionally forest in southern occurrences; 0-3,700 meters. Moist meadows, riparian zones, moist roadsides, openings and edges of cold forests.	S	D	D
Calochortus longebarbatus var. peckii	Grassy margins of wet meadows, and under pines; 1,600-1,800 meters. Wet to moist meadows. Along stream edges. Often partially shaded by ponderosa pine.	D	A	A
Carex idahoa	Riparian moist meadows, 2,000-2,600 meters. Driest communities of moist meadows, swales, and moist, low ground around streams and lakes, and on prairies and high plains as well.	D	S	S
Eleocharis bolanderi	Fresh, often summer-dry meadows, springs, seeps, stream margins; 1,000-3,400 meters. Wet places, low to mid-montane. In vernally wet swales. Along intermittent streams, moist meadows.	D	D	S
Gentianella tenella ssp. Tenella	*Gentianella tenella* appears to favor disturbed sites in subalpine to alpine meadows. Associated with high levels of sheep dung and bare ground. Around but not on hummocks.	A	D	A
Listera borealis	In moist, rich humus of mossy coniferous forest, swamps, often along cold streams, acidic soils. Most known sites in Washington are in older forests. Associated tree species include spruce, true firs, and Douglas-fir. Moderate elevations.	D	S	D
Phacelia minutissima	Moist meadow and seep edges, or on vernally wet open meadows and barren slopes. Reported to occur with aspen.	D	S	D

Scientific Name	Habitat Description	Malheur	Umatilla	Wallowa-Whitman
Ranunculus populago	Moist meadows, stream terraces, riparian corridors, open areas along the edge of shrubs, and adjacent to a perennial streams and bogs, at 4,480 to 5,920 feet (1,366-1,804 meters) elevation. Associated species at one or more sites include green false hellebore (*Veratrum viride*), Gray's licorice root (*Ligusticum grayi*).	A	D	A
Tauschia tenuissima	Grassy openings in moist-wet meadows, river floodplains and streambanks. 2580 to 3200 feet in WA. Assoc. spp: *Potentilla gracilis*), straight-beaked buttercup (*Ranunculus orthorhynchus*), wild strawberry (*Fragaria virginiana*), and blue-eyed grass (*Sisyrinchium inflatum*).	A	D	A

D: documented within the national forest, S: suspected to occur within the national forest; A: absent.

Wet Meadows – Affected Environment

Wet meadows are saturated throughout the growing season with the water table at or slightly below the soil surface. Species that inhabit moist meadows are displayed in the following table.

Table 372. Wet meadows habitat group description for each species

Scientific Name	Habitat Description	Malheur	Umatilla	Wallowa-Whitman
Antennaria corymbosa	Wet meadows, moist meadows; at mid elevations.	A	D	A
Botrychium montanum	Dark, coniferous forests, usually near swamps and streams; 1,000-2,000 meters. Wet meadows, saturated soils. Often growing in a bed of mosses. This species tends to grow in wetter sites than the other Botrychium species.	D	D	D
Carex atrosquama	Subalpine and alpine meadows, river gravels, shorelines. Wet meadows to dry open slopes.	A	A	D
Carex capitata	Wet or seasonally wet meadows, often alpine or lower in cold air drainages; sandy, acidic soils.	A	D	S
Carex comosa	Marshes, lake margins, wet meadows, bogs and wet thickets.	A	S	
Carex subnigricans	Moist rocky slopes, alpine meadows, high elevation only; above 2,500 meters.	A	A	D
Heliotropium curassavicum	Wet ground, saline flats, alkaline soils. Low elevations.	S	S	S
Juncus albescens	Peat bogs, peaty riparian areas. In the Wallowa Mountains, on a peaty creek bank in limestone drainage. High elevations.	A	A	D
Ophioglossum pusillum	Open fens, marshes edges, pastures, grassy shores and roadside ditches, 100-2,000 meters. Wet meadows, damp sand, grassy swales, seeps/springs. In pastures, old fields, and flood plain woodlands in seasonally wet, rather acid soil.	S	S	D

Scientific Name	Habitat Description	Malheur	Umatilla	Wallowa-Whitman
Pleuropogon oregonus	Open, wet meadows, marshes, and riparian areas. Grows in areas of standing or flowing water early in season. Known sites are not near forested habitats. Sluggish water in depressions and sloughs.	S	S	S
Salix farriae	Wet meadows, streambanks, moderate to high elevations. Sites in the Wallowa Mountains are in calcareous soils.	S	D	D
Salix wolfii	Stream banks, springs, wet meadows, bogs; 1500 to 1700 meters. Associates include Equisetum arvense, Ribes, Alnus, and Cynoglossum. Very rare on the Wallowa-Whitman (two known locations).	A	A	D
Thalictrum alpinum	Wet meadows, damp rocky ledges and slopes, and cold (often calcareous) bogs in willow-sedge, lodgepole pine, and spruce-fir forest; zero-3,800 meters. High elevations here.	A	A	D

D: documented within the national forest, S: suspected to occur within the national forest; A: absent.

Aquatic and Riparian Habitat Dependent Species – Environmental Consequences

Indirect Effects

The riparian habitats listed previously would be managed as riparian management areas where aquatic and riparian-dependent resources receive primary emphasis and where special management direction applies. Riparian management areas encompass lands adjacent permanently flowing streams, ponds, lakes, wetlands, seeps, springs and intermittent streams. Riparian management areas will have minimum widths but are designed to extend to the outer edge of riparian vegetation, or to the outer extent of the 100-year floodplain, whichever is greater. Riparian management areas are managed to maintain and restore the riparian dependent plant and animal species, enhance habitat conservation for organisms that depend on the transition zone between the upland and riparian areas, and provide for greater connectivity within and between watersheds for both riparian and upland species. Table 373 displays minimum widths for riparian management areas.

Table 373. Riparian management area widths

Category	Minimum Riparian Management Areas Width*
Fish bearing streams	300 feet slope distance on either side of stream or to outer edge of 100-year floodplain, whichever is greatest
Permanently flowing non-fish-bearing streams	150 feet slope distance on either side of stream or to outer edge of 100-year floodplain, whichever is greatest
Constructed ponds, reservoirs and wetlands greater than one acre	150 feet slope distance from the outer edge of wetland or from the maximum pool elevation, whichever is greatest
Lakes and natural ponds	300 feet slope distance
Seasonally flowing intermittent and ephemeral streams; wetlands smaller than 1 acres, and unstable areas	100 feet slope distance

*Additional delineation criteria apply, as described in the alternative descriptions

Within riparian management areas, activities would be designed to maintain properly functioning conditions or improve conditions in areas not functioning properly. Standards and guidelines direct management activities for a variety of activities, including wildland fire, fuels, timber, silviculture, range, domestic livestock grazing, roads, recreation, minerals, and hydropower to accomplish desired conditions. Most standards and guidelines seek to minimize impacts from land management activities. For example, guideline TM-3G directs new landings, designated skid trails, staging or decking for timber operations to be located outside riparian management areas, unless no reasonable alternatives exist, in which case they should (1) be of minimum size, (2) be located outside the active floodplain, and (3) minimize effects to large wood, bank integrity, temperature, and sediment levels. Several guidelines are specific to sensitive plants whether or not plants are located within the riparian habitat conservation area: FLS-5G, FLS-6S, FLS-7G,FLS-8G, FLS-9G, and FLS-11S that would protect populations of sensitive plants using avoidance buffers (Alternatives B, E, F). Guideline FLS-14G would require leasable mining activities to minimize adverse effects to federally listed and Forest Service sensitive plant species. For Alternatives E-Modified and E-Modified Departure, guidelines specify that adverse effects to sensitive plant species be minimized (FLS-4G, FLS-6G, FLS-7G, FLS-11-G, FLS-13G, FLS-16G).

The major difference in effects among Alternatives B, D, E, E-Modified, E-Modified Departure, and F with the effects of Alternative C concerns range management guideline GM-3G, where the maximum percent utilization of herbaceous vegetation within the riparian management areas is reduced from 40 percent (B, D, E, and F) to 10 percent (Alternative C). In Alternatives E-Modified and E-Modified Departure, riparian flood plain utilization would vary from 30-45 percent depending upon the ecological conditions. Woody vegetation utilization would be reduced from 40 percent to 20-30 percent, depending upon the ecological conditions. Residual stubble height and bank alteration standards remain the same between Alternatives B, D, E, and F, and are similar for E-Modified and E-Modified Departure with the greenline stubble height ranging from 4 to 6 inches depending upon conditions. Recreation management guidelines RM-1G, RM-2G that would bar placement of new facilities or infrastructure or move existing facilities within stream channel migration zones under Alternatives B, D, E, and F would become standards under Alternative C. There is no substantive change in their wording. Where aquatic and riparian dependent habitat is occupied by sensitive species, herbaceous utilization is further reduced to 30 percent under Alternatives B, E, and F. Riparian management areas within bull trout spawning and rearing reaches would be grazed to 25 percent utilization, providing slight additional benefits to sensitive plants inhabiting the riparian areas of these reaches.

The Livestock Grazing and Rangeland Vegetation section describes general effects to riparian vegetation. Alternative C is expected to result in the most rapid short-term recovery of riparian and wetland areas. Alternatives B, E and F are expected to have upward trends for riparian and wetland areas. Under Alternative A, riparian integrity would remain similar to the present, with a slow but steady rate of recovery. Sensitive plants benefitting from reduced riparian greenline vegetation utilization standards belong to the Aquatic and Riparian habitat groups. Reduced greenline utilization would mean livestock would spend less time in these areas, and there would be less opportunity to compact soils or damage plants from herbivory or trampling. Species benefiting from reduced trampling are small, fragile plants, particularly members of *Botrychium* and aquatic plants rooted in shallow or drying shorelines: *Rotala ramosior*, *Potamogeton diversifolius*, and *Elatine brachysperma*. One species, *Ribes oxyacanthoides* ssp. *irriguum*, a shrub growing in riparian areas in coniferous forest of ponderosa pine and Douglas-fir, would

directly benefit from Alternative C from a reduced standard for woody vegetation utilization to 25 percent of the current year's growth.

The alternatives vary also in the number of grazing animal unit months for each national forest. Presumably, how the animal unit months vary by alternative would not matter because overall vegetation utilization standards would still apply, regardless of the number of livestock allowed in to graze in any area. However, for Alternative C there would be a beneficial affect achieved through a combination of a reduction in animal unit months by 75 to 80 percent and a reduction in the acres designated suitable for grazing by about 65 percent. With fewer acres available for grazing and much reduced utilization levels, sensitive species impacted by grazing, even at levels that would sustain their populations, would benefit. The desired condition: "the natural range of habitats of… plant species… is of adequate quality, distribution, and abundance to contribute to maintaining native and desired nonnative species diversity," would be achieved more easily with Alternative C compared to other alternatives.

For Alternatives B, E, E-Modified, E-Modified Departure, and F, and guideline FLS-2G would not authorize grazing in peatlands. Sensitive plants occupying peatlands would not be impacted.

Findings

Effects of Alternative A

Alternative A has few standards or guidelines directing the management of sensitive plants. Alternative A includes a standard to conduct a biological evaluation for each project to determine the effects to sensitive species. The objectives and standards for biological evaluations are directed by the Forest Service Manual (FSM 2672.4). The Forest Service Manual directs the agency to "review all Forest Service planned, funded, executed, or permitted programs and activities for possible effects on endangered, threatened, proposed, or sensitive species" by conducting a biological evaluation. The biological evaluation is the means of conducting the review and documenting the findings. Forest Service objectives for sensitive species are "to ensure that Forest Service actions do not contribute to a loss of viability of any native or desired nonnative plant or contribute to animal species or trends toward Federal listing of any species" (FSM 2672.41). Therefore, Alternative A may impact individuals or habitat, but would not likely contribute to a trend towards Federal listing or cause a loss of viability to the population or species.

Effects of Alternatives B, E, E-Modified, E-Modified Departure, and F

Although some individual sensitive plants of aquatic habitats may be impacted, the guidelines specific to sensitive plants are expected to maintain populations for Alternatives B, E, and F. These five alternatives would provide greater protection than Alternatives A and D. Sensitive species occupying riparian areas, including springs and seeps, would benefit from the desired condition designed specifically to conserve these unique groundwater dependent ecosystems and managed using standards and guidelines for riparian management areas as wetlands smaller than one acre. At 30 percent forage utilization of key species, some sensitive plants would be impacted; however, the majority of plants, as well as the overall integrity wetland habitats, would be maintained. The biological evaluation finding is may impact individuals or habitat, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.

Effects of Alternative C

Alternative C would result in the fewest impacts to sensitive plants among the alternatives through the reduction in livestock AUMs, a reduction in land area deemed suitable for grazing, and a ten percent maximum utilization of riparian herbaceous vegetation. This level is little more than incidental use and is expected to have few impacts to riparian dependent sensitive plants. While Alternative C may still result in impacts to individual sensitive plants or habitat, these impacts would not likely contribute to a trend towards Federal listing or cause a loss of viability to the population or species in the Plan Area.

Effects of Alternative D

No specific standards and guidelines directing the management of sensitive species are proposed under this alternative; therefore, any consideration of the needs of sensitive species would default to higher level policy encoded in the Forest Service Manual as described under Alternative A. The maximum utilization level of key forage species in riparian management areas under Alternative D would be 40 percent. This may be adequate to sustain the vegetation, but is uncertain how the proposed increase in AUMs would affect sensitive plants inhabiting riparian habitats. If we assume the 40 percent utilization would be met, the result may be the maximum utilization is reached over most or all of the riparian areas. Alternative D would result in the greatest impact to sensitive species through both herbivory and trampling. Localized impacts exceeding 40 percent utilization would be expected given the high number of AUMs. Species in moist meadows, riparian and intermittent stream habitat groups would likely be maintained at viable levels because these habitats are not saturated during the grazing season and are less vulnerable to trampling. Sensitive plants in the wet meadows, springs and seeps, and peatlands habitat groups would be most at risk to trampling due to season long saturated conditions. Species in these three habitat groups may experience localized impacts to the degree that population viability within the Plan Area would be compromised.

Aquatic, moist meadow, riparian and intermittent stream habitat group: may impact individuals or habitat, but would not likely contribute to a trend towards Federal listing or cause a loss of viability to the population or species.

Wet meadows, springs and seeps, and peatlands habitat groups: individual plants or their habitat may be impacted with a consequence that the action may contribute to a trend towards Federal listing or cause a loss of viability to the population or species.

Cumulative Effects

Because of the expected life of the plan, cumulative effects to rare plants would arise mainly from reasonably foreseeable future actions or events occurring beyond the Plan Area whose effects might extend to within the Plan Area. These effects would originate from actions on adjacent public lands (Bureau of Land Management), state, county, or private lands, and for the Wallowa-Whitman National Forest, the Hells Canyon National Recreation Area. Private lands comprise the largest proportion of adjacent lands followed by Bureau of Land Management, state, and county lands. The actions or events outside the national forest most likely to contribute to cumulative area invasions by nonnative plants and wildfires. Trespass by livestock is possible, but is expected to be infrequent with minor cumulative effects. The effects of climate change also contribute potential cumulative effects to rare plants.

Non-native Invasive Plants – Cumulative effects from invasion by nonnative plants would arise from lands nearby the Plan Area. The plan addresses these effects in the same manner as effects

from nonnative plants spreading from sites within the Plan Area. These effects are discussed in the Non-native Invasive Species section. The Hells Canyon National Recreation Area includes plan direction to manage invasive plants. This direction is additive to plan components under all alternatives. Management of invasive plants on the adjacent Hells Canyon National Recreation Area would help reduce the incidence of invasive plants migrating from the national recreation area to the Wallowa-Whitman National Forest.

Wildland Fire – Wildfires arising from adjacent lands then spreading to within the Plan Area mainly threaten rare plants located within 5 to 10 miles of the national forest boundary. Rare plants in the conifer forest habitat group are at the greatest risk of lethal effects from wildfire. Wildfires with severe or perhaps even moderate intensities would likely kill plants in this habitat group. Following severe wildfire, suitable habitat for species in the conifer habitat group may not return for several decades. Species in the aquatic, peatlands, and wet meadows habitat groups would probably be least affected from wildfire because these groups are expected to withstand the effects of wildfire, suffering damage only to crowns of graminoid plants, but not the basal meristem tissues of the root crown. Species occupying the grasslands habitat group are largely adapted to periodic wildfire, and may benefit from them. Increases in nonnative exotic plants, such as cheatgrass, may increase fire frequencies in the grasslands habitat group favoring increase in exotic species cover to the detriment of native bunchgrasses, though this pattern, widely reported from the basin and range, has not been observed in the Blue Mountains. Alpine fellfields and subalpine parkland are not expected to be frequented by wildlife, though it is possible. Any cumulative effects from wildlife to this habitat group are expected to be minor. In sagebrush shrubland, some species (*Astragalus tegetariodes, Camissonia pygmaea*) may benefit from the presence of wildlife while *Castilleja flava* var. *rustica* may experience decline because sagebrush may be a necessary host plant for this hemiparasite. Although wildfire is possible in the basalt lithosol habitat group, any effects are expected to be minor due to light fuel loads. On the other hand, species inhabiting the talus, cliffs, and rock outcrops habitat groups are threatened by wildfire. These species' strategy of avoidance by occupying areas with light, discontinuous fuels is not foolproof as wind driven wildfires spot through these habitats. Many species occupying this group have no inherent defenses for fire, particularly the cryptic nonvascular plants that grow on peaty soil on ledges and in crevices. Mat-forming plants such as *Geum rossii* var. *turbinatum* and *Luina serpentina* would be consumed and killed by fire. Species occupying the seeps/springs, riparian, and intermittent stream habitat groups could either survive or be killed by wildfires, depending on fire severity. Most species occupying moist meadows are not expected to be significantly impacted by wildfire. Wildfire management direction for the Hells Canyon National Recreation Area is very similar to the plan revision alternatives and would supplement direction in the plan revision alternatives.

Climate Change – The assessment of current environmental conditions in the affected environment incorporates the combined effects of past action. Ongoing and reasonably foreseeable future actions are addressed under the analysis in environmental consequences. Because the Forest Plan has an anticipated lifespan of 15-20 years, this analysis incorporates the effects of reasonably foreseeable future actions. When forest plan activities are considered within a context of climate change, an additional factor is added to the cumulative effects analysis. Reid and Lisle (2008) identified two issues regarding cumulative impacts and climate change:

1. Human-induced climate change is itself a cumulative impact of multiple human activities. Prediction of the local magnitude, style, and timing of climate changes will require an understanding of how the many influences on climate interact.

2. Outcomes from this episode of climate change will differ from those of previous episodes in part because of interactions with environmental changes that humans have already caused—outcomes will be a cumulative effect. For example, Pleistocene climate changes resulted in elevational and latitudinal shifts of ecosystem boundaries. However, ecosystems now are highly fragmented by land-use activities, so climate change is more likely to result in extirpations than in the past because incremental shifts along a gradient may no longer be possible. In addition, geomorphic and ecosystem processes have been extensively modified by land-use activities, impairing some systems' mechanisms for resilience and thereby increasing their sensitivity to change.

Climate change is affecting the Pacific Northwest. Projections are for the climate to warm 0.2 to 1 degree Fahrenheit per decade for the foreseeable future (OCCRI 2010). Precipitation levels may be more difficult to predict, but there is some confidence to expect decreases in winter snowpack, earlier spring snowmelt, earlier initiation of growing seasons, increase in growing season length, but under drier conditions, and increases in extreme weather events. Gradual warming and drying is expected to change species composition and community structure, possibly resulting in a decline in biodiversity. The most significant effects of climate change on biological diversity are expected to be in response to increasing summer temperatures (Currie 2001), although there is too much uncertainty about potential climate change effects on rare plant populations to confidently distinguish differences between the alternatives. The Blue Mountains are expected to experience decreased snowpack and earlier snowmelt resulting in earlier and higher peak stream flows and lower summer low flows, drier summer soil conditions. Warming temperatures are expected to cause gradual changes in the abundance and distribution of plant communities throughout the Blue Mountains with more drought tolerant species becoming competitive. Ecological disturbance, including wildfire and insect outbreaks, will be the primary facilitator of vegetation change, and future forest landscapes may be dominated by younger age classes and smaller trees. High-elevation forest types will be especially vulnerable to disturbance. Increased abundance and distribution of nonnative plant species will create additional competition for regeneration of native plant species. As climate continues to warm during the 21st century, the most rapidly visible and significant short-term effects will be caused by altered disturbance, often occurring with increased frequency and severity. Increased disturbance will be facilitated by more frequent extreme droughts, amplifying conditions that favor wildfire, insect outbreaks, and invasive species (Halofsky and Peterson 2017).

Species occupying the alpine fellfields and subalpine parkland habitat group are most at risk from climate change as this habitat has been and will continue to decline in the next century. Species dependent on snow melt basins or other moist micro sites (*Carex vernacula*, *C. micropoda*, *Lomatium erythrocarpum*, and *Saxifraga adscendens* ssp. *oregonensis*) are also at risk, as these habitats may decline first. Species or habitats dependent on snowmelt runoff, such as the cottonwood habitat group, may decline in abundance. Cottonwoods depend on period flooding and sediment deposition for seedling germination (Mahoney and Rood 1998). With reduced peak spring streamflows, cottonwood seedlings may not have proper conditions to germinate on floodplains. Where germination has been successful, reduced late summer discharge may not provide sufficient moisture for seedlings to survive through the first growing season and establish (Naiman et al. 2005). Cottonwood, willow and aspen may be replaced by upland vegetation in some areas (Halofsky and Peterson 2017). Many other species within the Plan Area are endemic to small ranges or comprise disjunct populations beyond the species' contiguous range, regardless of their habitat group. These species are at risk of local extinction due to factors cited earlier.

The likelihood of forest, woodlands and shrublands being invaded by nonnative annual grasses in a warmer climate will increase because of more disturbance, effects of warming on species distributions, enhanced competitiveness of nonnative plants from elevated carbon dioxide, and increased stress to native species (Halofsky and Peterson 2017). Warming alone may increase the risk of nonnatives, because many invasive species have range limits set by cold temperatures, which has tended to limit their establishment in forests, particularly the higher elevation and continental western forests.

A species distribution model that assumed lower (summer) precipitation in the future projected expansion of cheatgrass in a warmer climate. Because of the fire and invasive grass cycle, changes in future fire regimes are important climate considerations for nonnative annual grasses. More area burned, more frequent large wildfires, larger extent of high-severity fire, longer wildfire durations, and longer wildfire seasons are expected in the future, thus increasing the invasion risk of nonnative annual grass species. Of particular concern in the Blue Mountains is the recent increase in North Africa grass and its apparent ability to outcompete and replace areas dominated by cheatgrass (Halofsky and Peterson 2017).

In shrubland and grassland systems, increased area burned will likely lead to increased mortality of shrub species and native grasses, and increased abundance of nonnative species, annual grasses in particular (Halofsky and Peterson 2017). Adaptation strategies and tactics to address these sensitivities include increasing the resilience of native ecosystems through grazing management (i.e., avoid grazing practices that promote invasive species establishment), active restoration of less resilient sites (e.g., plant natives on sites dominated by invasive species), and management of soil resources to maintain stability and productivity (e.g., establish native vegetation to stabilize eroded areas).

Nonnative Invasive Species

Changes Made Between the Draft and Final Environmental Impact Statements

Aside from the global changes throughout this environmental impact statement described in the Preface to this document (see Volume 1), the following changes were made specifically to this section:

- Effects discussions were expanded or clarified to respond to comments on the Draft Environmental Impact Statement.

Methodology

Invasive species are recognized as a major threat to native plant and animal communities, as well as to social and economic conditions. The effects of invasive species can cause economic loss and reductions in the long-term productivity of the land, disrupt recreational use, and reduce resource production. A wide range of species can be invasive, including vascular and nonvascular plants, terrestrial and aquatic animals, and pathogens, such as white pine blister rust and white-nose syndrome.

Invasive aquatic plants and animals are not yet widespread in the headwater streams and lakes in the Blue Mountains. However, many highly invasive aquatic species are well established in neighboring states, in the Columbia River, and in the lower reaches of major tributaries adjacent to the National Forests. Streams and springs on the National Forests are at risk of invasion by

detrimental invasive organisms, such as New Zealand mudsnails and Asian clams. Lakes and reservoirs are at risk of invasion by zebra mussels, hydrilla, and other highly undesirable introduced plant and animal species. Because the distribution of invasive aquatic plants and animals in the Blue Mountains is not well understood, the analysis emphasizes invasive terrestrial plant species. Exotic insect infestations and diseases that threaten conifer forests are addressed in the vegetation section.

Invasive plants are defined as "nonnative plants whose introduction do or are likely to cause economic or environmental harm or harm to human health" per Executive Order 13112. The Chief of the Forest Service declared invasive species as one of the four main threats to ecosystem health (USDA Forest Service 2004). The threat is considered serious because invasive plants have the potential to displace or change native plant communities and can increase wildfire hazard, degrade fish and wildlife habitat, eliminate rare and endangered plants, impair water quality and watershed health, and adversely affect a wide variety of other resource values, such as recreational opportunities.

The area affected by invasive plant species has increased throughout the Interior Columbia Basin during the last 100 years. The same trend has occurred in the Blue Mountains during the last 20 years. A large portion of the Blue Mountains is characterized as being susceptible to invasive plants (Quigley and Arbelbide 1997). The susceptibility is most prevalent in vegetation types that many invasive plants are adapted to: areas dominated by dry forest, dry grass, dry shrub, and cool shrub types.

This section discusses the analysis of how well invasive plants forest plan components (objectives, standards, and guidelines) would achieve the desired condition. The existing condition describes the current infestation of invasive plants for each national forest and describes the 1990 Forest Plan direction for managing invasive plants.

The methodology supports analysis to answer two central questions:

1. Do the alternatives achieve the desired condition?
2. How do the alternatives vary in the degree to which planned activities would create ground disturbances that may favor an introduction or spread of invasive species?

Assumptions:

- Plan objectives to "reduce current infestations of invasive plant species," as measured in acres, would be funded and achieved.
- Control measures, whether manual, chemical, or biological control, may need to be applied more than once to invasive plant sites. The percent control, the reduction in the ability of the invasive plant to propagate, is assumed to be 80 percent (USDA Forest Service 2005, Desser 2006).

Nonnative Invasive Species – Affected Environment

Invasive plants occupy thousands of acres within the Umatilla and Wallowa-Whitman National Forests, but far fewer acres are inventoried within the Malheur National Forest. The Malheur National Forest is thought to have more acres of invasive plants than what is currently mapped but is not likely infested to the same degree the Umatilla or Wallowa-Whitman National Forest is infested. Table 374 displays the known infested acres for each national forest. Within the Malheur National Forest, 30 species infest 2,160 acres; within the Umatilla National Forest, 37 species

infest 27,755 acres; and within the Wallowa-Whitman National Forest, 37 species infest 20,352 acres.

Other infestations that have not been inventoried are likely to occur on each national forest. In addition, annual grasses and other invasive plants that are considered naturalized are not included in this total.

Table 374. Acres and percent of National Forest System (NFS) lands infested by invasive plants

National Forest	Current Infestation (acres)	Total NFS lands* (acres)	NFS Lands Infested by Invasive Plants (%)
Malheur	2,160	1,709,047	0.13%
Umatilla	27,755	1,404,246	2.0%
Wallowa-Whitman	20,352	1,777,596	1.1%

*For the Wallowa-Whitman National Forest, values exclude the Hells Canyon National Recreation Area.

The desired condition for the plan revision alternatives is that healthy, native and desired nonnative animal communities and native and desired nonnative plant communities dominate the landscape and are resilient given current and projected climate conditions. Invasive species and other undesirable species (terrestrial and aquatic plants and animals) are absent or occur in small areas and have limited or no impacts on viability of native and desired nonnative species. Existing invasive and undesirable species do not expand their current distributions over the life of the plans, and their current distributions are reduced to the extent possible over that period of time. Invasive and undesirable species do not significantly diminish the ability of the National Forests to provide the goods and services that communities expect or the habitat that plant and animal community diversity depends upon. New invasive species resulting from changes in plant and animal habitats due to changes in climate occur only at low levels.

Current Forest Plan direction has the potential to meet the desired condition. The Preventing and Managing Invasive Plants Final Environmental Impact Statement disclosed that the adopted invasive plant management direction had a “moderate to high potential to reduce rate of spread,” and concluded that effective treatment of the existing populations along with prevention measures applied to land uses and activities could reduce the current 8 to 12 percent rate of spread to about 4 to 6 percent (USDA Forest Service 2005). Thus, to meet the desired condition, both current infestations and new infestations need to be contained, controlled, or eradicated.

Nonnative Invasive Species – Environmental Consequences

Indirect Effects

In 2005, the regional forester amended the 1990 Forest Plans with the Record of Decision for the Preventing and Managing Invasive Plants Final Environmental Impact Statement (USDA Forest Service 2005). This amendment added management direction for invasive plants to the 1990 Forest Plans, including goals, objectives, standards and a monitoring framework. Appendix A displays the goals, objectives, and standards from the R6 2005 Record of Decision. Current Forest Plan direction for managing invasive plants would continue for the no-action alternative and Alternatives B, C, D, E and F. Modified direction for invasive plant prevention and treatment is a component of Alternatives E-Modified and E-Modified Departure. These modified alternatives retain as standards or guidelines, the intent of preventive standards under the 2005

plan amendment (Alternative A). The modified alternatives, however, do not restrict, at the plan level, the kinds of pesticide active ingredients that could be used when implementing invasive species treatments. The decision of which active ingredient and how it should be applied would be analyzed at the project level.

Forest Plan Components – Objectives

Table 376 displays the average annual acres that have been treated during a three-year period (2009-2011) on the three National Forests compared to the acres that would hypothetically need to be treated each year to make progress toward achieving the desired condition for invasive plants containment, control, and eradication. The objectives span a five-year period because of the time it takes to control invasive plants given the existing soil seed bank, the typical need for retreatment, weather, and funding. To effectively control invasive plants, treatments (manual, mechanical, herbicide, or biological) are often repeated for several years. Subsequent treatments usually require fewer resources, e.g., labor or herbicides, because each treatment effectively reduces the density or size of the target population. The acreage needed to be effectively treated annually in Table 376 was adjusted to account for need for retreatment (each entry is assumed 80 percent effective) (Desser 2006).

Plan objective 1.5 is to “reduce current infestations of invasive plant species.” Projected acres of invasive plants that would be reduced under the alternatives are displayed below in Table 375. Acres reduced is not equivalent to acres treated; it is likely that repeat treatments over 2 or more years would be required to eradicate or severely reduce the cover of an invasive plant infestation. The figures in the table denote the total acres reduced over the 10-year period; annual reduction objectives would be 1/10th of these amounts. For example, for the Umatilla and Wallowa-Whitman National Forests, objectives for annual acres reduced range from 700 (Alternatives B, C, E, E-Modified, E-Modified Departure) to 1,500 acres (Alternative D).

Table 375. Acres projected to reduce invasive plants during the first decade of the plans to achieve objective 1.5

National Forest	Alternatives B, C, E, F (acres)	Alternative D (acres)	Alternatives E-Modified and E-Modified Departure (acres)
Malheur	1,500	3,000	1,500
Umatilla	7,000	15,000	7,000
Wallowa-Whitman	7,000	15,000	7,000

Table 376 displays that invasive plant treatments need to be increased from current levels to meet 5-year objectives for all alternatives. Forest plan management direction is intended to facilitate effective treatments over time.

Table 376. Annual acres of invasive plants treatments necessary to make progress towards achieving the desired condition for each national forest

National Forest	Average Acres Treated Annually (2014-2016)	5-year Benchmark (acres contained, controlled, eradicated)	Average Acres of Effective Annual Treatments Needed
Malheur	552	2,270 to 3,470	570 to 868
Umatilla	5,383	33,770 to 48,913	8,433 to 12,228
Wallowa-Whitman	2,277	24,760 to 35,870	6,190 to 8,968
Totals	8,212	60,800 to 88,253	15,193 to 22,064

The recent three-year average of acres of invasive plants treated annually for each of the Blue Mountains national forests falls short of estimates for acres of effective annual treatments needed to achieve five-year objectives displayed in Table 376 to make progress toward achieving desired conditions. Although the three-year averages for acres treated does not predict future accomplishments or objectives, they do demonstrate what the forests are capable of accomplishing under recent budget allocations. These data show that the continuation of the recent record of annual treated acres may not be sufficient to cover the amount of area necessary to move the forests toward desired conditions. Although the Malheur National Forest recent average treated acres is quite near the estimated annual acres needing effective treatments, the figures for both the Umatilla and Wallowa-Whitman National Forests fall several thousand acres short of the area needing effective treatments annually to progress toward desired conditions.

Forest Plan Components – Standards and Guidelines

The environmental consequences of plan components among Alternatives A, B, C, D, E, and F are the same because these alternatives retain existing management direction for invasive species under Alternative A. Alternatives E-Modified and E-Modified Departure have differently worded standards and guidelines, but are intended to achieve the same results through preventive measures. In other words, plan components for the preventing the establishment of invasive species do not measurably vary between alternatives. The main difference of Alternatives E-Modified and E-Modified Departure with the other alternatives is that Alternatives E-Modified and E-Modified Departure do not specify or restrict the types of herbicides that may be used to manage invasive plants. Under these two alternatives, the decision of which herbicides that would be used to manage invasive plants would be decided during project level analysis and decision-making.

Preventive measures under the alternatives include plan standards and guidelines IS-2S, IS-3G, IS-4G that apply to all invasive species, including invasive animals (e.g., aquatic or terrestrial vertebrates and invertebrates). IS-1G applies specifically to aquatic invasive species and specifies measures to avoid cross contamination of waterbodies. National forests in the Blue Mountains would continue to follow strategies outlined in the National Strategy and Implementation Plan for Invasive Species Management and the Regional Aquatic Invasive Species Strategy and Management Plan (2011) for prevention and early detection/rapid response. These plans emphasize coordination with state and local agencies to increase public awareness of exotic pests, especially where visitors have the potential to spread organisms, and to monitor water resources for the presence of invasive aquatic organisms.

Forest Plan Components – Disturbance Potential from Forest Management Activities

All alternatives were assessed to determine the relative degree to which ground disturbance could lead to conditions that would favor the establishment and spread of invasive plants. Because invasion and dominance by invasive plants is highly correlated to soil disturbances (Cox 1999), the greater the potential extent and intensity of ground-disturbing activities such as timber harvest, fuels reductions, motorized recreation, livestock grazing, mining operations, road maintenance and prescribed fire, the greater the potential for these activities to create conditions favorable to invasive plants. To compare alternatives by the degree to which ground disturbing activities could lead to further introduction and spread of invasive plants, an index was created to display the relative amount of soil disturbing activities (timber harvest and associated actions, activity fuels management, and animal unit months for livestock grazing) for each alternative for each national forest. These activities were used as a surrogate for all potential ground-disturbing activities because they are the most widespread across the Blue Mountains national forests. The

index equals the sum of annual projected acres of these soil-disturbing activities divided by the sum of these values for Alternative A, no action (the continuation of current management). The index values for the alternatives are displayed in Table 377. The index value for Alternative A is 1. Other alternatives are measured relative to Alternative A. No standard exists for measuring the magnitude of soil disturbance as a predictor of nonnative plant invasion, either as an observable measurable value or as a percent of managed lands. The index serves only to compare alternatives and suggest which alternatives are more or less likely to create conditions favorable to the invasion of nonnative invasive plants. All alternatives include management direction to prevent or minimize the potential for invasive species introduction, establishment, and spread.

Table 377. Index values for soil-disturbing actions that favor invasion by nonnative plants for each of the plan revision alternatives for each national forest

National Forest	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. E-Modified	Alt. E-Modified Departure	Alt. F
Malheur	1	1	0.37	1.01	0.89	1.08	1.17	0.84
Umatilla	1	1	0.37	1.49	1.14	0.96	1.16	1.03
Wallowa-Whitman	1	0.97	0.39	1.19	1.09	1.14	1.28	1.01
Blue Mountains Average	1	0.88	0.34	1.17	1.01	1.07	1.20	0.94

Compared to the proposed action, Alternatives B and F would have slightly fewer projected activities that would create disturbance conditions where nonnative invasive plants could. Alternatives D and E-Modified Departure, having about 20 percent more projected ground disturbing activities, would create the most area favorable conditions for establishing invasive plants. Projections for Alternative C are about one third of the projections for Alternative A and would likely result in the least amount of disturbed ground area favoring the spread of invasive plants. Compared to Alternative A, Alternative E-Modified has moderately higher projections (about 7 percent more) for ground disturbing activities conducive to the establishment of invasive plants. All management activities would be designed to with measures to help prevent the establishment and spread invasive plants; however, the Forest Service recognizes that while prevention measures can ameliorate the conditions that promote the spread and establishment of invasive plants, these measures are not 100 percent effective. As more acres of ground are disturbed, more outbreaks of invasive plant infestations would be expected, though fewer outbreaks than if no prevention measures were applied.

Cumulative Effects

Cumulative effects may arise from the introduction of invasive species from lands adjoining the Plan Area. These lands consist of other Federal (Bureau of Land Management), Tribal, State, county, or largely, privately owned lands. The plant invasion process occurs in three phases: introduction, establishment, and spread. Invasive species are introduced via vectors, such as wind, water, or wildlife, in addition to the actions of people, which move seeds or plant fragments from one location to another. Wind and water, in particular, are major natural dispersal agents. For example, windblown seed of rush skeleton weed can be carried up to 20 miles (USDA Forest Service 2005). Water is a primary aid in the dispersal of many species, including Japanese knotweed. Rivers and waterways have been identified as one of the biggest spread mechanisms for invasive plants (Sheley et al. 1995). Various wildlife species can contribute to the spread of

invasive plant species by dispersing seeds in their dung, on their coats or feathers, or between their hooves. Ants even have been identified as one of the dispersal agents for the seeds of Scots broom (Parker, et al. 1998). Though invasive plant propagules (seeds or plant fragments capable of establishing) may originate from outside sources, the Forest Service does exert management control on conditions on the ground where they may be deposited. Therefore, the cumulative effects analysis area is the Plan Area for the Blue Mountains national forests.

People travelling to the National Forests may transport invasive plant propagules from adjacent or even distant lands. This may be done through a variety of means: motor vehicles, clothing and footwear, pets, stock, etc. Motor vehicles, in particular, have been shown to pick up and move invasive species seeds that can be deposited along roads (Schmidt 1989 and Hodkinson and Thompson 1997). Roadside habitats are particularly susceptible to plant invasions for a number of reasons. Roads eliminate some of the physical and environmental barriers that help prevent invasion by increasing available light and dispersal opportunities. Disturbances associated with the use and maintenance of roads provide habitat easily exploited by invasive species, which can then seed themselves relatively swiftly along roadsides or be transported by animals or people (vehicles). Roads are primary vectors for the spread of invasive plants and the most likely vector for human transport of invasive plant propagules from outside the Plan Area.

Cumulative effects may be incurred from the transport and establishment of nonnative invasive plants from sources adjacent to the Plan Area. Likewise, weeds from the National Forest System lands could spread to adjacent areas. However, these effects are expected to be small compared to the anticipated spread from invasive plants sites within the Plan Area. While the Forest Plan addresses invasive plant spread via prevention standards, invasive plants would continue to move freely across borders, to and from ownerships, because the movement of seeds and propagules via wind, water, or wildlife are largely beyond the control of the Forest Service.

Cumulative effects may also result from climate change. Much of the research on invasive species interactions with climate change has contributed to the growing body of evidence that global warming has enabled invasive species to expand to areas where they were not previously able to persist (Dukes and Mooney 1999, Weltzin et al. 2003, Thuiller et al. 2007, and Walther et al. 2009). Some researchers have modeled range expansions for some invasive species (*Centaurea solstitialis* and *Tamarix*) while predicting reduced invasion risk and significant range contractions for others (*Bromus tectorum*, *Euphorbia esula*, and *Centaurea biebersteinii*) by the year 2100 (Bradley et al. 2009). As the climate changes, the ranges of invasive species will change: some species may become less invasive, and others may become more invasive. Given their adaptive traits, invasive plants may be able to outcompete native species in the migration process to new suitable habitat (Hellman 2008). Compared to a stable climate, the degree to which global warming has contributed to the current spread of invasive plants is unclear.

In the Blue Mountains, a warming climate is expected to increase disturbance cycles, risking an increase in the distribution of invasive annual grasses in grasslands, shrublands, and warm, dry forests (Halofsky and Peterson, eds. 2017). Because of the fire and invasive grass cycle, changes in future fire regimes are important climate considerations for nonnative annual grasses. More area burned, more frequent large wildfires, larger extent of high-severity fire, longer wildfire durations, and longer wildfire seasons are expected in the future, thus increasing the invasion risk of nonnative annual grass species. The likelihood of forest, woodlands and shrublands being invaded by nonnative annual grasses in a warmer climate will increase because of more disturbance, effects of warming on species distributions, enhanced competitiveness of nonnative plants from elevated carbon dioxide, and increased stress to native species. Of particular concern

in the Blue Mountains is the recent increase in North Africa grass and its apparent ability to outcompete and replace areas dominated by cheatgrass. Adaptation strategies and tactics identified in *Climate Change Vulnerability and Adaptation in the Blue Mountains* (Halofsky and Peterson, eds. 2017) to address these sensitivities include increasing the resilience of native ecosystems through grazing management (i.e., avoid grazing practices that promote invasive species establishment), active restoration of less resilient sites (e.g., plant natives on sites dominated by invasive species), and management of soil resources to maintain stability and productivity (e.g., establish native vegetation to stabilize eroded areas).

The Forest Plan responds to the challenges of increased risk of invasion from invasive plants, whether or not introduced from external sources and whether or not climate change may influence their spread, by incorporating standards to prevent the transport and establishment of invasive plant propagules and by including objectives to reduce the area infested by invasive plants over time. The cumulative effects do not add significantly to effects expected from each alternative. Cumulative effects, when added to indirect effects of the alternatives, would be similar to the effects described previously.

Social Environment

Tribal and Treaty Resources

Introduction

The Forest Service has unique legal responsibilities to American Indian tribal governments as set forth in the Constitution of the United States (Article VI, Clause 2), treaties, statutes, Executive Orders, and court decisions. The support for tribal sovereignty and the special government-to-government relationship between the Tribes and the United States is further outlined in Executive Order 13175 (November 9, 2000). The Forest Service honors American Indian treaty reserved rights to hunt, fish, gather, and graze on present-day national forests through consultation, coordination, and agreements with the affected Indian Tribes. The Forest Service and the Tribes take time to meet to gain an understanding of each other's rights, responsibilities, and interests. Through these relationships, the Forest Service and the Tribes build and enhance a mutual understanding, as well as pursue cooperative and partnership initiatives and efforts.

Numerous laws, executive orders, and regulations govern the relationship between American Indian Tribes and the Federal government, which is represented here by the three National Forests. In project planning and implementation, the Forest Service complies with these laws and regulations, and, in doing so, meaningfully consults with tribal governments.

In addition, numerous laws, regulations and policies govern the use and protection of forest resources that may be of tribal interest or covered under tribal reserved rights. Activities authorized or implemented by the Forest Service must comply with these laws, regulations, and policies that are intended to provide general guidance for the implementation of management practices, and for protection of resources, including those of interest to the Tribes.

In the Plan Area, a significant portion of lands ceded by the Tribes in the various treaties was designated as part of the National Forest System by the Organic Administration Act of June 4, 1897. Lands were ceded though the Treaties of 1855 by the Confederated Tribes of the Umatilla Indian Reservation, Confederated Tribes of Warm Springs, Nez Perce Tribe, and Confederated Tribes and Bands of the Yakama Indian Nation of the Yakama Reservation. The treaty with the Klamath Nation of 1870 ceded lands extending into the Malheur National Forest. These treaties are known for their specific language recognizing certain reserved rights of the Tribes in aboriginal use areas. The Burns Paiute Tribe, Shoshone-Paiute Tribes of the Duck Valley Reservation, Fort McDermitt Paiute and Shoshone Tribes, Fort Bidwell Indian Community of Paiute Indians, and the Confederated Tribes of the Colville Reservation (through the Joseph Band of the of the Nez Perce Tribe) are federally recognized American Indian Tribes that also have interests in the management direction and project planning of the Blue Mountains national forests.

Changes Made Between the Draft and Final Environmental Impact Statements

Aside from the global changes throughout this environmental impact statement described in the Preface to this document (see Volume 1), the following changes were made specifically to this section:

Revised Forest Plan Content

- In response to numerous comments on the Draft Revised Forest Plan and environmental impact statement that expressed concerns for increased tribal consultation, a forestwide standard was developed to expressly direct each National Forest's staff to use consultation processes established with American Indian tribal governments. The consultation processes will help facilitate identifying and managing areas of tribal importance on National Forest System lands.

  Similarly, a Federal Trust Responsibilities and Tribal Rights and Interests section was developed and included in Part 2 – Strategy, under the Management Focus section. The additional material serves to emphasize the important and unique relationship between the Tribes and the Forest Service, and serves to further integrate these ongoing consultations with each National Forest's sustainability goals.

- In response to additional comments from the tribal communities, additional statements were developed for inclusion in each goal statement that highlights the integration of culturally significant foods and other resources with the National Forest's ecological, social, and economic goals. Many of the culturally related goals to steward ecosystem values important to tribal communities are closely related to meeting the desired conditions for other resources including wildlife habitat, forested vegetation, and soil and air quality.
- Through ongoing consultation and public engagement with tribal communities, additional resource types were added to Cultural Resources (section 2.5) to include resources considered in the National Environmental Policy Act and section 106 of the National Historic Preservation Act. These additional resource types include "properties of traditional religious and cultural importance to American Indian Tribes."
- Law and regulation citations were clarified in the Final Environmental Impact Statement in response to commenters requesting either corrections to the draft documents or inclusion of specific statutory reference.

Tribes and Forest Plan Revision

As a Federal agency, the Forest Service's legal responsibilities are identified in treaties and clarified in statutes, executive orders, and case law enacted and interpreted for the protection and benefit of federally recognized Tribes. In meeting these responsibilities, the Forest Service consults with the Tribes whenever proposed policies or management actions may affect their interests.

While Federal laws apply to all federally recognized Tribes, each tribe is different and is recognized as a separate and unique government. Treaty rights and the historic relationships between the Tribes and the lands differ and there are cultural differences between them. In some cases, several Tribes may each have legitimate interests in the same lands because they each may have occupied or otherwise used those lands during different historic periods or jointly during the same period. In other cases, a tribe or a group of Tribes has a Memorandum of Understanding with the Forest Service. These factors and others combine to make each Forest Service tribal consultation relationship unique.

Tribal officials have been invited to participate in forest plan development since the beginning of the revision efforts (2003). As part of the planning process, Forest Supervisors, staff, and planning team members met with tribal staff, committees, and leadership, as well as members who attended public meetings. The Forest Service sent letters regarding the Blue Mountains

forest plan revision to interested tribal governments in 2004, 2006, 2007, 2009, 2010, and 2013. Numerous meetings were held with the Confederated Tribes of the Umatilla Indian Reservation, Nez Perce Tribe, and Confederated Tribes of the Warm Springs between 2002 and publication of this Final Environmental Impact Statement. These include government-to-government and staff-to-staff meetings. During this period, the Blue Mountains forest plan revision team has received formal comments from Confederated Tribes of the Colville Reservation (2007), the Nez Perce Tribe (2007), and the Confederated Tribes of the Umatilla Indian Reservation (2007, 2008, and 2011).

The following Tribes submitted formal comments in response to the February 2014 publication of the Draft Environmental Impact Statement and Draft Revised Forest Plan: Confederated Tribes of the Umatilla Indian Reservation, Nez Perce Tribe of Idaho, and Shoshone-Bannock Tribes of the Fort Hall Indian Reservation. In the Blue Mountains planning

Further details of tribal consultation are included in Chapters 1 and 4 of this Final Environmental Impact Statement and in the project record (details of Forest Service communications with the Tribes regarding this project are available in the project record including correspondence letters, presentation and working draft material, and staff-to-staff and government-to-government meeting notes).

Culturally Significant Foods

The Tribes are concerned about the availability and protection of treaty resources, including culturally significant foods. These culturally significant foods are plants, animals, and fish that are used for both ceremonies and subsistence needs. According to the Tribes, the protection of culturally significant foods includes the protection of habitats, upon which those resources depend, and use and access to traditional cultural sites. Adequate availability of these resources allows harvest in sufficient quantities to satisfy the subsistence needs of Tribes while still providing for the conservation needs of the resources. Adequate access that would not compromise cultural practices at traditional, cultural, or spiritual places is a concern to the Tribes.

Traditional foods in the Pacific Northwest include water, salmon, game (such as elk and deer), roots (such as cous, camas, and bitterroot), and berries (such as huckleberries and chokecherries). These plants and animals, as well as water and other resources, have cultural significance. They also provide nutrition to many tribal people. Culturally significant foods are especially important and provide critical subsistence given the high incidence of poverty in Native American communities.

Affected Environment – Tribal and Treaty Resources

The affected environment includes the treaty reserved resources the Tribes use within the Blue Mountains national forests. The affected environment, including the current conditions of treaty resources, is discussed in the related resource sections of Chapter 3. The affected environment for indirect effects is the lands administered by the Malheur, Umatilla, and Wallowa-Whitman National Forests.

Environmental Consequences – Tribal and Treaty Resources

Management direction for tribal treaty reserved rights and interests is included in all alternatives for the three National Forests and can be found in greater detail in Appendix A.

Key Issues for Tribal Treaty Reserved Rights, Interests, and Culturally Significant Foods

Consultation, collaboration, and coordination with tribal communities would continue to inform on overall resource condition, however the following selected measures are indicators of resource condition that are of tribal interest. The key issues for tribal concerns are access, vegetation management, and watershed function. The following indicators are relevant to tribal and treaty rights and detailed analysis of effects for these indicators between alternatives is available in the respective sections.

Effects Common to All Alternatives

Forest plan direction for resource management, such as heritage, vegetation, soils, water, riparian, aquatic, and wildlife for all alternatives, is designed to provide for the protection of cultural resource sites or traditional cultural properties. All alternatives would also provide protection for habitat and watershed conditions that would contribute to species viability at sustainable and harvestable levels. Invasive species would be managed to avoid encroachments on culturally significant foods. Monitoring of resource conditions would also occur.

Effects Common to Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F

Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F would result in the following common conditions. The following are desired future conditions that are common to all plan revision alternatives.

Access

The access issue includes the impacts on tribal governments and tribal practices from resource management activities including road building or other modifications of the landscape. The Forest Plans would include the desired condition that “the need for Tribal access to traditional sites is acknowledged and supported.” While the tribes need access to traditional sites, there are some sacred sites where American Indians conduct ceremonies that require privacy. Building roads to or near such sites may lead to increased visitation that could affect ceremonies and undermine cultural practices. Roads or extraction activities may also alter the character and diminish the value of historic or cultural places. Adequate access should not compromise cultural practices at traditional, cultural, or spiritual places.

The indicators for access are:

- Acres suitable for summer motor vehicle use

Access will vary by alternative due to stated desired conditions for road density, wildlife habitat requirements, and watershed restoration needs. For all alternatives, tribal access will be retained for tribal members to access traditional sites and resources, and for sustaining treaty reserved rights and interests.

Refer to the Access section for detailed discussion on these indicators. Alternatives with higher road densities would provide for greater tribal access but may also result in greater impacts to resources of value to the tribes such as culturally significant foods, which are dependent on terrestrial and aquatic habitats. Alternatives with lower road densities would slightly impact accessibility, particularly for elders, of forest resources for tribal accessibility. While there may be some variation between the alternatives for access, tribal treaty rights will be protected in all alternatives from impacts resulting from access management.

Culturally Significant Foods and Vegetation Management

The availability of culturally or traditionally significant foods is one aspect of vegetation management that is of particular importance to the tribes. Culturally significant foods are plants, animals, and fish that are used for both ceremonies and subsistence needs. According to the tribes, the protection of culturally significant foods includes the protection of habitats upon which those resources depend. Adequate availability of these resources allows harvest in sufficient quantities to satisfy the subsistence needs of tribes while still providing for the conservation needs of the resources.

The following indicator is used to assess vegetation management:

- Acres of annual timber harvest
- Acres of annual fuels treatment

Vegetation management activities would be designed to move the forested landscape closer toward the historic range of variability. These indicators are appropriate because forests that are closer to their historic range of variability support more culturally significant foods. Refer to the Forest Vegetation, Timber Resources, and Wildland Fire section for detailed information on annual acres treated.

The amount of annual acres of timber harvest and prescribed burning varies between alternatives; however, the following desired future conditions are common to all plan revision alternatives and can be found in Appendix A.

The amount of acres of annual forest vegetation treatments vary by alternative. In general, alternatives that have more acres treated would result in larger areas of the forested landscape returning to the historic range of variability, which support more culturally significant foods. Alternatives with lesser amount of vegetation treatments may also return the forested landscape to the historic range of variability, but at slower pace and scale. The Forest Vegetation, Timber Resources, and Wildland Fire section provides detailed analysis of these indicators.

Watershed Function

The availability of clean water is important to the tribes. Some tribes also consider clean water a culturally significant food. Clean water is part of the watershed function issue. The indicators of clean water are:

- Aquatic species viability
- Watershed condition class: number of watersheds in improved condition

Culturally significant foods and watershed function are both related to ecological resiliency. The tribes are particularly concerned about ecological resiliency. Some of the tribes have participated in planning efforts aimed at improving elk and big game habitat as well as partnered with the Forest Service for the removal of culverts impacting fish passage. The tribes are interested in ecological resiliency as it relates to ecological restoration projects for aquatic and terrestrial resources including salmon and big game. The indicators listed above for vegetation management and watershed function are also useful for determining progress toward ecological resiliency. Refer to the Aquatic and Watershed sections for detailed discussion on the indicators for each alternative.

The number of watersheds with improved conditions varies by alternative. Alternative C improves the largest number of watersheds, Alternatives D, E, E-Modified, E-Modified

Departure, and F represent an intermediate amount, and Alternative B improves the least. Alternatives with more watersheds in improved condition are beneficial for water quality and aquatic species viability, each considered resources of tribal interest. See the Watershed Function, Water Quality, and Water Uses section for detailed analysis of this indicator.

Environmental Justice

Environmental justice is discussed in the Economic and Social Well-being section. The desired future conditions are consistent for all plan revision alternatives.

American Indian populations would not be disproportionately impacted by any alternative. Environmental justice as it relates to tribes is analyzed in detail in the Economic and Social Well-being section.

Cumulative Effects

The affected environment for cumulative effects includes lands administered by the three National Forests and lands of other ownerships both within and adjacent to these national forest boundaries, and the time period considered was the planning period. The Hells Canyon National Recreation Area, under the administration of the Wallowa-Whitman National Forest, contains culturally significant foods and resources resulting from the ecosystem functions present within the National Recreation Area. The Hells Canyon National Recreation Area Comprehensive Management Plan, a part of the Wallowa-Whitman National Forest 1990 Forest Plan, includes added protections for these resources as outlined in Section 7 of the Hells Canyon National Recreation Act (P.L. 94-199).

While there is variation between alternatives within the current analysis, all alternatives would contribute to the exercise of treaty reserved rights, interests, and cultures in a manner that promotes ecosystem sustainability. The need for tribal access to traditional sites is acknowledged and supported for all alternatives for all National Forest System lands administered by the Malheur, Umatilla, and Wallowa-Whitman National Forests. All resources on all three National Forests would be managed in accordance with laws, regulations, executive orders, and Forest Service policies and management direction.

Recreation

The Malheur, Umatilla, and Wallowa-Whitman National Forests are important local and national recreation destinations. Recreation and related tourism, especially during hunting season, is a major component of the rural economy in northeastern Oregon. The Plan Area includes all National Forest System lands within a portion of the Ochoco, and all of the Malheur, Umatilla, and Wallowa-Whitman National Forests, with the exception of the Hells Canyon National Recreation Area. The 2014 National Visitor Use Monitoring survey recorded more than 500,000 recreation visits to the Blue Mountains national forests.

Survey data for Forest Service related recreation were collected and analyzed for the National Visitor Use Monitoring system. Data for the first survey were collected between 2000 and 2003. The second round of National Visitor Use Monitoring data were collected for the three National Forests in 2009, and a third round of National Visitor Use Monitoring data were collected for the three National Forests in 2014. The scientists conducting the National Visitor Use Monitoring survey state that comparisons of the first and second round results are not appropriate due to

changes in the study protocols. Round 3 results of the 2014 National Visitor Use Monitoring data are presented in the following table.

Table 378. Total national forest site visits

National Forest	Number of Visits
Malheur	160,000
Umatilla	168,000
Wallowa-Whitman	246,000

National forest recreation provides a wide range of opportunities in a natural setting to meet the needs and desires of visitors. People have always enjoyed relatively un-restricted vehicle access and opportunities in federal public lands. There are also areas of national forests that have been accessible only by foot, horseback, and bike. Local lifestyles and economics are closely linked to the type and amount of recreation that is occurring in the Blue Mountains, with a majority of the visitors coming from within two hours of the national forest in which they recreate. The climate and demographics in the Blue Mountains national forests sustain a summer and fall recreation program. Elevation and snow conditions sustain a strong winter recreation program in much of the project area.

Each National Forest has established use patterns, with a large percent of users coming from the counties that are associated with each of the National Forests. Wallowa-Whitman National Forest visitors are predominately from Union and Baker counties. Umatilla National Forest visitors are predominately from Walla Walla and Umatilla counties. Malheur National Forest visitors are predominately from Grant and Harney counties. However, considering the distances that are involved, there is a considerable amount of visitation from major metropolitan areas, such as Portland and Seattle, and most importantly secondary population centers that have very high growth rates. Examples of these areas, such as the Tri-Cities area (Benton and Franklin counties in Washington), Bend (Deschutes county in Oregon), and Boise (Ada County in Idaho), have high population growth rates with a large percent of the population desiring to take advantage of outdoor recreation opportunities in the nearby National Forests. These large populations and high growth rate areas will have an increasing effect on recreation opportunities and demands within the Blue Mountains national forests. The following table displays visitation to the National Forests by county (top three counties) (NVUM 2014), and the county populations and growth rates (2010 Census).

As displayed in Table 379, the rural counties for all three National Forests have the highest visitation and the lowest growth rates, and in some cases population losses. The metropolitan centers have a low percent of visitation, but the population is large and growing at a much greater speed then the national average. The Umatilla National Forest has the greatest potential for increasing visitation due to the higher rural population and the higher metropolitan population, both growing at a greater rate than the other two forests.

Within the Plan Area for the Blue Mountains national forests, Congress has designated 11 wild and scenic river segments and 6 wilderness areas. In addition, there are four designated scenic byways, including the Hells Canyon All-American Road. An extensive road system is used by recreation visitors for recreation pursuits that include hunting, fishing, accessing motor vehicle and nonmotorized trail systems, camping, picking huckleberries, viewing wildlife, driving for

pleasure, and riding over-the-snow vehicles in the winter. Winter recreation is popular, with three downhill and Nordic ski areas and extensive miles of groomed snowmobile routes.

Table 379. Recreation visitation by county for each national forest

County in each National Forest	State	Percent Visitation	County Population	Change in Population 2000 to 2010
Malheur National Forest				
Grant County	Oregon	54.9%	7,445	-6.2%
Harney County	Oregon	17.0%	7,442	-2.5%
Deschutes County	Oregon	10.4%	157,733	36.7%
Umatilla National Forest				
Umatilla County	Oregon	27.3%	58,781	6.5%
Walla Walla County	Washington	25.1%	75,889	7.6%
Benton County	Washington	24.3%	175,177	23.0%
Wallowa-Whitman National Forest				
Union County	Oregon	33.7%	25,748	5.0%
Baker County	Oregon	23.1%	16,134	-3.6%
Wallowa County	Oregon	9.6%	7,008	-2.8%

The Forest Service initiated and developed a framework for sustainable recreation entitled, “Connecting People with America’s Great Outdoors: A Framework for Sustainable Recreation” (USDA Forest Service 2010). The framework affirms the USDA Forest Service mission and concludes:

> Despite changes in population and fluctuations in visitor patterns, it is obvious that outdoor recreation on the National Forests and Grasslands is a traditional part of the American way of life, and will remain so in the years ahead. There are numerous challenges to providing quality recreation experiences and tourism opportunities while protecting the land. But, through the strength of our partnerships . . . we can meet these challenges of a sustainable future for the benefit of American society.

The purpose of sustainable recreation is to create recreation and tourism programs and services that directly contribute to the long-term ecological, social, and economic health in a specified area by building partner relationships between visitors, communities, and providers. Sustainable recreation is currently defined as the set of recreational opportunities, uses and access that, individually and combined, are ecologically, economically, and socially sustainable, allowing the responsible official to offer recreation opportunities now and in the future.

In the past, additional Forest Service funding has been allocated through the American Recovery and Reinvestment Act of 2009 to reduce the backlog of maintenance issues for numerous recreation facilities. This funding has been particularly effective for trail maintenance and developed recreation facilities, with the Forest Service receiving a different mix of funds for each national forest:

- $1.7 million to focus on correcting recreation facilities maintenance issues and accessibility upgrades within the Malheur National Forest

- $1.6 million to address 1,400 miles of wilderness area and Hells Canyon National Recreation Area trails maintenance within the Wallowa-Whitman National Forest
- $1.7 million to correct recreation facilities maintenance issues and $2.8 million to replace trail bridges and to accomplish heavy trail maintenance within the Umatilla National Forest

It is anticipated that this additional funding will have a positive effect on the Blue Mountains national forests recreation and trails facilities over the next decade.

An additional diversity of recreation settings has also been provided with special area designations in the 1990 Forest Plans. These special areas have specific management direction for their designation, and while many provide a motor vehicle or nonmotorized recreation setting, they are designated for other purposes, such as historical significance or preservation of unique ecosystem components. Where motor vehicle use is deemed suitable, it is because that recreation activity does not interfere with the purpose for which the area was designated. See the Special Areas section for more discussion.

Changes Made Between the Draft and Final Environmental Impact Statements

Aside from the global changes throughout this environmental impact statement described in the Preface to this document (see Volume 1), the following changes were made specifically to this section:

Revised Forest Plan Content

- In response to numerous comments on the Draft Revised Forest Plan and environmental impact statement that expressed concerns regarding aviation use on the forest, additional material was included in the plan recognizing the importance of aviation and backcountry airstrips as a recreational use and administrative infrastructure on the National Forests. The Forest Service recognizes the importance of maintaining collaboration with recreational aviation users for supporting Forest Service airstrip programs including operation, rehabilitation, maintenance, and continued public use as outlined in the “Service-Wide Memorandum of Understanding Between the Recreational Aviation Foundation and the USDA Forest Service, Washington Office” (2015).
- In response to comments on the Draft Revised Forest Plan and Draft Environmental Impact Statement, an additional forestwide guideline was developed to provide additional management direction for recreation-related projects to maintain consistency with mapped classes and setting descriptions in the recreation opportunity spectrum.
- In response to public comments requesting additional recreational opportunities, the forestwide Goal 2.6 (Roads and Trials Access) Desired Condition was modified to recognize the opportunity to provide connectivity between Forest Service recreation sites, and to connect these sites with adjacent communities through pathways, trails, bike lanes, and waterways, and to provide loop-riding opportunities.
- In response to Forest Service reviews conducted for the Final Environmental Impact Statement, Guideline BHS-5S was modified. The modification changes “source habitat” to “core range.” The modification may result in a smaller restriction area compared to the 2014 Draft Revised Forest Plan. See the wildlife section for additional information and complete analysis. The guideline, through implementation, may result in impacts to recreational pack goat use that would be concentrated to those areas of core native bighorn

sheep habitat across the Blue Mountains national forests. Current use is by recreational pack goat enthusiasts and there is no authorized outfitter and guide use.

Recreation – Affected Environment

Recreation Settings

Recreation Setting Suitability

Key indicators for recreation setting suitability are:

- acres of back country motor vehicle, backcountry nonmotorized, and wilderness/recommended wilderness
- acres of winter motor vehicle access
- acres available for motor vehicle and nonmotorized hunting access

The Blue Mountain Revised Forest Plans and Final Environmental Impact Statement established management areas that describe areas where general management intent is similar. The purpose of management areas is to provide consistent guidance for similar portions of national forest landscape when implementing or continuing management activities. The management areas generally range along a continuum from little development by humans in Management Area 1A (Designated Wilderness) to extensive human development in Management Area 5 (Developed Sites and Administrative Areas).

The recreation opportunity spectrum has been used as a framework for identifying, classifying, planning, and managing a range of recreation settings. Six distinct settings are defined using specific physical, managerial, and social criteria and include urban, rural, roaded natural, semi-primitive motorized, semi-primitive nonmotorized, and primitive. Detailed information on recreation opportunity spectrum categories and criteria are presented in the Recreation Opportunity Spectrum User Guide, 1982 USDA Handbook, and the Recreation Opportunity Spectrum Primer and Field Guide, 1990 USDA, R6-REC-021-90. Additional information and applications are outlined in the Forest Service Directive System, specifically Forest Service Manual 2311 and 2330.

Recreation opportunity spectrum classes can be associated with each of the established management areas. Each management area may have more than one recreation opportunity spectrum setting. The analysis presented below is focused on general setting comparisons between management areas—and their expected settings—rather than the typical recreation opportunity spectrum categories. Corresponding recreation opportunity spectrum classes appropriate to each management area are described in management area descriptions and desired conditions and establish expectations for recreation setting characteristics.

For each recreation setting, there is a table depicting the results of the most recent National Visitor Use Monitoring survey data (NVUM 2014). After identifying their main recreation activity, visitors were asked how many hours they spent participating in that main activity during the national forest visit. Because most national forest visitors participate in several recreation activities during each visit, it is more than likely that other visitors also participated in this activity, but did not identify it as their main activity. For example, in one national forest, 39 percent of visitors identified viewing wildlife as a recreational activity that they participated in during the visit; however, only 1.3 percent identified that activity as their main recreational activity.

The demographic results from the National Visitor Use Monitoring survey indicate that the majority of visitors come from counties contiguous or adjacent to the Blue Mountains national forests. The National Forests serve as federal "backyards" to moderate population areas for activities that are not often available in the private sector (viewing scenery and wildlife, developed and primitive camping, hiking, and walking).

Existing Condition of Developed Recreation

High to moderate use levels occur at well-maintained recreation sites. Developed sites across the National Forests, including campgrounds, picnic areas, boating sites, and ski areas, continue to provide varied recreation facilities. Developed recreation sites act as a central hub of activity, with many people recreating on roads, trails, creeks, lakes, and rivers near the site. Continued access to developed sites is of central importance, while maintaining access to these nearby attractive locations is of equal importance. About one-half of the visits to the Blue Mountains national forests are to developed sites: 39 percent visit day use areas and 11 percent visit overnight camping areas (NVUM 2014). This equates to about 270,000 visits to developed sites in the Blue Mountains national forests.

A recreation facility analysis has been completed for all three of the National Forests to determine a program of work for facilities management. As a general observation across the Blue Mountains national forests, the use of facilities within all three forests was determined to be below capacity, so additional facility construction is not anticipated. However, in certain locations which are particularly popular or near towns where facilities are not meeting user expectations or use is at full capacity, additional recreation facilities may be constructed in suitable areas (Malheur National Forest Recreation Site Facility Master Plan, May 2006, Wallowa-Whitman National Forest Recreation Site Facility Master Plan June 2006, Umatilla National Forest Recreation Site Facility Master Plan, October 2007).

Table 380. Percent of developed site recreation visits

National Forest	Participated or Primary Visit	Developed Camping	Resort Use	Nature Center	Historic Sites	Picnicking
Malheur	Participated	15.1	0.3	1.8	9.5	8.6
Malheur	Primary	2.5	0.0	0.0	0.0	0.9
Umatilla	Participated	18.0	1.5	2.0	2.6	8.3
Umatilla	Primary	8.8	0.0	0.0	0.2	0.7
Wallowa-Whitman	Participated	13.1	2.3	12.8	15.4	18.4
Wallowa-Whitman	Primary	2.6	0.1	0.3	0.2	2.4

Source: National Use Visitor Monitoring 2014

The forest plan revision team has addressed the importance and special need for management of developed sites by allocating developed recreation sites to the same management area as administrative sites (MA 5). In the existing condition, Alternative A, there are a total of 12,680 acres in MA 5. Approximately 50 percent of these acres are associated with recreation facilities, and the remaining acres are associated with administrative use by the Forest Service. For the plan revision alternatives, additional acres would be allocated to MA 5, and this allocation would be the same for each of the plan revision alternatives, except for an increase in MA 5 acres for the Umatilla National Forest for Alternative E-Modified and E-Modified Departure.

Table 381 displays the acres currently allocated to developed recreation and administrative sites for each of the Blue Mountains national forests. For this analysis, developed recreation and administrative areas will not be used as an indicator, as they will not vary by alternative and would not contribute to a comparison of the alternatives. As noted above, Alternatives E-Modified and E-Modified Departure would increase the acres allocated to MA 5. The increase reflects additional administrative area allocations such as sand and gravel pit sources and expands existing administrative site areas to allow for improved maintenance activity for such sites. The increase in MA 5 acres, specifically for only one forest, does not necessitate including developed recreation and administrative areas as an indicator.

Table 381. Existing condition displaying acres of developed recreation and administrative site setting

National Forest	Acres of Developed Recreation and Administrative Site Settings
Malheur	650
Umatilla	4,920
Wallowa-Whitman	7,110

Existing Condition of Dispersed Backcountry Motor Vehicle Recreation Areas

Table 382 and Table 383 display activity participation for dispersed backcountry motor vehicle use activities for each National Forest.

Table 382. Percent of motor vehicle dispersed and backcountry recreation visits

National Forest	Participated or Main Activity	Primitive Camping	Relaxing	OHV Use	Motor Vehicle Trail	Driving for Pleasure	Motor Vehicle Water Activity	Other Motor Vehicle Activity
Malheur	Percent Participated	40.2	43.3	1.3	1.3	9.6	0.6	16.8
Malheur	Percent Main	3.6	2.4	0.4	0.0	2.3	0.0	0.0
Umatilla	Percent Participated	9.3	33.2	3.0	3.3	24.6	1.0	0.5
Umatilla	Percent Main	1.8	4.7	0.7	0.5	2.0	0.4	0.0
Wallowa-Whitman	Percent Participated	6.7	48.3	2.1	2.8	26.5	11.1	0.5
Wallowa-Whitman	Percent Main	0.2	10.5	0.4	0.9	3.2	9.3	0.0

Source: National Use Visitor Monitoring 2014

Table 383. Existing condition displaying acres of dispersed backcountry motor vehicle setting

National Forest	Acres of Dispersed Backcountry Motor Vehicle Setting
Malheur	14,700
Umatilla	11,900
Wallowa-Whitman	119,900

Existing Condition of Dispersed Backcountry Nonmotorized, Recommended Wilderness, and Wilderness Recreation Areas

Low to high use can occur in many backcountry and wilderness sites, depending on the location, and especially depending on proximity to water. Frequently, the pristine nature of a setting becomes the primary reason it is attractive to the exclusion of other sites that may be easier to access, but are much less pristine. The desire to get away from others for a remote or pristine recreation opportunity can create a crowded situation at desirable and relatively easily accessed sites, or a situation where those seeking a pristine setting must look to locations farther away to achieve the desired recreation experience. Pristine recreation settings are at a premium and can be difficult to maintain from the manager's standpoint.

Hiking, walking, horseback riding, mountain biking, snowshoeing, cross-country skiing, nature study, and viewing wildlife have been and continue to be popular backcountry activities, as reflected in Table 384. Backcountry recreation users usually do not support any change to the way they have been accessing an area. They know they have to hike, ride horses, or ride bikes (in nonwilderness areas) into the area, and they would like it to remain that way. Frequently, for an area to be considered pristine by recreation users, avoidance of the sights and sounds of others or of motor vehicles is necessary. The table below displays activity participation for nonmotorized backcountry and wilderness use activities for each National Forest.

Table 384. Percent of nonmotorized backcountry and wilderness area recreation visits

National Forest	Participated or Main Activity	Hiking/ Walking	Back-packing	Horse-back Riding	Bicycling	Other Non-motorized Activity	Nature Study	View Natural Features
Malheur	Percent Participated	28.3	0.0	0.0	0.5	3.4	2.8	22.1
Malheur	% Main	4.5	0.4	0.0	0.0	1.5	0.0	3.0
Umatilla	Percent Participated	36.6	0.0	2.9	4.8	0.5	4.2	43.1
Umatilla	Percent Main	7.1	1.2	1.2	2.3	0.0	0.0	18.1
Wallowa-Whitman	Percent Participated	43.7	0.0	3.0	3.8	6.3	9.8	46.8
Wallowa-Whitman	Percent Main	10.5	1.9	2.1	0.2	0.2	0.2	8.7

Source: National Use Visitor Monitoring 2014

In some areas, there are management goals that are associated with fish, wildlife, and water that may also be beneficial to nonmotorized recreation experiences. Areas may also have other resource management goals that are associated with excluding motor vehicle activities from an area. These areas will be considered as suitable for nonmotorized backcountry recreation for the purposes of this analysis.

There are management areas in Alternative A where this type of recreation activity is provided and for which the area is managed. These include MA 1A Congressionally Designated Wilderness Areas, MA 1C Wilderness Study Area, and MA 3A Backcountry (nonmotorized use). Acres of Blue Mountains National Forests currently allocated to these management areas are displayed in Table 385 and Table 386. There are no recommended wilderness areas in the 1990 Forest Plans.

Table 385. Existing condition displaying acres of dispersed backcountry nonmotorized setting

National Forest	Acres of Dispersed Backcountry Nonmotorized Setting
Malheur	47,500
Umatilla	29,800
Wallowa-Whitman	0

Table 386. Existing condition displaying acres of designated wilderness areas

National Forest	Acres of Designated Wilderness
Malheur	82,557
Umatilla	304,173
Wallowa-Whitman	373,676*

* Wallowa-Whitman National Forest private inclusions are included in the acre totals for congressionally designated wilderness areas in the existing condition

Existing Condition of Winter Recreation

Winter recreation occurs in all of the areas described previously. Due to the increased difficulty, challenges of access, and need for specialized equipment and clothes designed for winter activities, winter recreation in the Blue Mountains is far less common than summer recreation. However, winter recreation has significant tourism effects for the communities of the Blue Mountains because visitors from outside the area predominately use local lodging and restaurants. In addition, downhill and cross-country ski areas have a disproportionately large daily visitation compared to all other developed sites in the National Forests. As reflected in Table 387, downhill skiing, cross-country skiing, and snowmobiling each have active participation across the Blue Mountains national forests. Visitors travel great distances to ride in deep snow in wide-open high-elevation areas. Snowmobiling is a controversial topic, with parties interested in maintaining or expanding snowmobiling, and other parties seeking to restrict or eliminate it. In Alternative A, snowmobiling is identified as a suitable use and is allowed in approximately 1,575,500 acres within the Malheur National Forest, in approximately 1,061,700 acres within the Umatilla National Forest, and in approximately 1,369,200 acres within the Wallowa-Whitman National Forest.

Table 387. Percent of winter recreation visits

National Forest	Participated or Main Activity	Downhill Skiing	Cross Country Skiing	Snowmobiling
Malheur	Percent Participated	0.0	0.0	0.8
Malheur	Percent Main	0.0	0.0	0.8
Umatilla	Percent Participated	10.4	0.4	0.3
Umatilla	Percent Main	10.2	0.4	0.1
Wallowa-Whitman	Percent Participated	8.4	4.0	1.2
Wallowa-Whitman	Percent Main	7.1	3.0	1.2

Source: National Use Visitor Monitoring 2014

The following table is repeated from the "Access" section.

Table 388. Areas suitable for winter motor vehicle use (existing condition/1990 Forest Plans)

National Forest	Acres Suitable for Winter Motor Vehicle Use	Percent of National Forest
Malheur	1,575,500	93%
Umatilla	1,061,700	76%
Wallowa-Whitman	1,369,200	78%

Existing Condition of Hunting and Fishing

Table 389 includes the National Visitor Use Monitoring (2014) survey information gathered for visitors participating in fishing, hunting, viewing wildlife, and gathering forest products. The National Forests of the Blue Mountains maintain a reputation as one of the best places to hunt big game in the Pacific Northwest. Hunting continues to be a featured recreation activity and, in some areas, the single most important recreation activity. Hunting access is a complex topic, as some hunters prefer a high amount of motor vehicle access while others prefer large reductions in motor vehicle access. Regardless, minimal road systems have been proven desirable to manage habitat of the big game species that are hunted. As additional roads are closed to improve big game habitat, there will be a reduction in the easy access afforded by those roads.

Table 389. Percent of Hunting and fishing recreation visits

National Forest	Participated or Main Activity	Fishing	Hunting	Viewing Wildlife	Gathering Forest Products
Malheur	Percent Participated	9.7	76.4	30.0	15.5
Malheur	Percent Main	2.9	72.4	1.1	0.8
Umatilla	Percent Participated	15.7	26.7	28.8	14.1
Umatilla	Percent Main	6.2	24.3	0.8	8.3
Wallowa-Whitman	Percent Participated	17.3	8.8	46.3	14.7
Wallowa-Whitman	Percent Main	7.6	7.1	4.5	10.5

Source: National Use Visitor Monitoring 2014

Nationally, hunting has seen a declining trend. During the last two decades, participation rates of Oregon residents in hunting and angling have declined significantly. Even though Oregon's population has expanded by nearly a million people, the number of licensed resident hunters has declined in absolute numbers, and the number of licensed resident anglers has not increased. Of the adjacent states of California, Idaho, Nevada, and Washington, only Nevada and Idaho hunters have not declined in numbers. For the same adjacent states, anglers have increased in all four states (Staff Report, Oregon Department of Fish and Wildlife, Review of License Sales Trends, Chris Carter, Harry Upton).

Among the most important factors identified in the literature and hypothesized as causes of the trends are:

- Changing values/attitudes toward wildlife – shift from utilitarian/traditionalist attitude to protectionist attitude

- Urbanization (the social process in which the populations of cities and suburbs grow relative to the populations of rural areas)
- Residential stability has declined, reducing the number of people with a stable, rural background and decreasing the prevalence of individuals with both area knowledge and a utilitarian attitude
- Increasing difficulties in gaining access to fish and wildlife
- Increasing pace of life – not enough time, increasing work obligations, family obligations
- Declining conditions of some fish and wildlife populations
- A population with greater average age, composed of more persons with lower physical fitness and fewer persons with a traditionalist attitude
- Fee increases have caused some individuals to quit or become less frequent participants

The trend in county participation rates has similar negative implications. Oregon net in-migration represents the majority of population growth between the 1990 and 2000 Census. Most of the counties with the largest population gains from in-migration are more urban/suburban counties. Many of the counties associated with the Blue Mountains have had overall population decreases. Table 390 displays the change in annual hunter participation rates for each county by comparing the 2003 participation rate to the 1991 rate. For each county, participation rates have decreased.

Table 390. Relative difference in hunter participation rates by county (from 1991 to 2003)

County	Percent Change in Hunting Participation 1991 to 2003
Harney	-7
Wheeler	-15
Wallowa	-19
Malheur	-27
Morrow	-26
Baker	-26
Union	-5
Umatilla	-27

Fishing access is another complex topic. Fishing participation has increased nationwide, but has only held steady in Oregon in spite of population growth. Oregon state data indicates many of the counties within the project area have reduced participation rates. Some anglers prefer easy access to fishing sites, while others would like reductions in motor vehicle access and prefer to fish where there are no roads at all.

Table 391 displays the change in annual fishing participation rates for each county by comparing the 2003 participation rate to the 1991 rate. For each county, participation rates have decreased.

Table 391. Relative difference in fishing participation rates by county (from 1991 to 2003)

County	Percent Change in Fishing Participation 1991 to 2003
Harney	-12
Wheeler	-20
Wallowa	-14
Malheur	-33
Morrow	-24
Baker	-27
Union	-13
Umatilla	-23

Hunting and fishing is an important part of recreation activities in the Blue Mountains; however, it is difficult to determine benefits or losses to the activities based on the variability of factors. Many aspects of an enjoyable hunting and fishing experience are within the control of state fish and wildlife management agencies, including increases or decreases in game populations from year to year, difficulty or cost of obtaining tags, and locations where certain types of hunting or fishing may occur. One aspect of the hunting or fishing experience that could be affected by the forest plan revision is the availability of motor vehicle access.

The National Forests provide two principle types of recreation: recreation at developed sites, where activities are dependent on constructed facilities, for example RV camping and downhill skiing; and dispersed recreation, where the activities are not dependent on constructed facilities, for example hunting, fishing, and off-highway vehicle use. Where there is a low road or motor vehicle trail density in a dispersed setting, the setting is considered backcountry.

Useful indicators of differences between alternatives within a dispersed or backcountry setting are the acres of land allocations suitable for motor vehicle use and the acres of land allocations suitable for nonmotorized use. This topic is also discussed in the Access section.

Table 392 and Table 393 are repeated from the “Access” section of this chapter.

Table 392. Areas suitable for motor vehicle use (existing condition/1990 Forest Plans)

National Forest	Acres Suitable for Motor Vehicle Use	Percent of National Forest
Malheur	1,428,050	84%
Umatilla	934,240	67%
Wallowa-Whitman	1,315,750	75%

Table 393. Areas suitable for only nonmotorized use (existing condition/1990 Forest Plans)

National Forest	Acres Suitable for Nonmotorized Use	Percent of National Forest
Malheur	272,010	16%
Umatilla	460,150	33%
Wallowa-Whitman	438,580	25%

Recreation – Environmental Consequences

This analysis considers the effects to recreation setting suitability that are associated with a motor vehicle use or a nonmotorized use designation for both summer and winter recreation.

Effects associated with changes in the road or trail system for either density or suitability are discussed in the access section.

Effects associated with a change in allocation to Preliminary Administratively Recommended Wilderness Areas are discussed in the wilderness area section.

Recreation Setting Suitability

The indicator for recreation setting suitability is:

- acres available for dispersed backcountry motor vehicle, dispersed backcountry nonmotorized, and wilderness/recommended wilderness

Effects from Alternative A on Recreation Setting Suitability

The 1990 Forest Plans for the Malheur and Umatilla National Forests include designations for areas for nonmotorized recreation that are primitive in nature, while the Wallowa-Whitman National Forest 1990 forest plan does not. There are areas within all three National Forests that are designated for motor vehicle recreation that are primitive in nature, or classified as backcountry, with very low densities of motor vehicle roads. The Umatilla National Forest is closed to cross-country motor vehicle travel, unless posted open. In contrast, the travel management approach for the Malheur and Wallowa-Whitman National Forests has been that areas are open to cross-country motor vehicle travel unless closed by order. All three National Forests have road density limitations as plan components, although they vary by national forest. Refer to the Access section for more information.

Developed Recreation

Effects from Alternative A on Developed Recreation

The Blue Mountains National Forests1990 forest plans have inconsistent approaches to developed recreation sites.

There is a management area designated specifically for developed recreation sites for the Malheur and Umatilla National Forests. Developed recreation sites are included in a management area with other administrative sites for the Wallowa-Whitman National Forest. For Alternative A, there would be a variety of management areas within the three National Forests where developed recreation would be appropriate and encouraged. For the purpose of this analysis, the management area designation developed in the proposed action will be used: MA 5 Developed Sites and Administrative Sites. To determine how this recreation setting is affected by proposals in each alternative, the total acres available in this allocation will be compared (Table 394 through Table 396).

Table 394. Acres of recreation setting allocations, including acres from more than one management area, for each alternative for the Malheur National Forest

Recreation Setting Suitability	Alt. A	Alt. B	Alt. C	Alt. D	Alts. E and F	Alts. E-Modified and E-Modified Departure
Developed recreation	650	2,200	2,200	2,200	2,220	2,200
Dispersed backcountry motor vehicle	1,482,100	1,554,300	885,600	1,614,800	1,543,500	1,554,200
Dispersed backcountry nonmotorized (including wilderness and recommended wilderness areas)	226,950	154,700	823,400	94,200	165,500	154,800

Table 395. Acres of recreation setting allocations, including acres from more than one management area, for each alternative for the Umatilla National Forest

Recreation Setting Suitability	Alt. A	Alt. B	Alt. C	Alt. D	Alts. E and F	Alts. E-Modified and E-Modified Departure
Developed recreation	4,900	3,700	3,700	3,700	3,700	7,500
Dispersed backcountry motor vehicle	934,200	1,047,800	523,800	1,068,500	884,600	913,200
Dispersed backcountry nonmotorized (including wilderness and recommended wilderness areas)	469,700	356,100	880,100	335,400	519,300	490,700

Table 396. Acres of recreation setting allocations, including acres from more than one management area, for each alternative for the Wallowa-Whitman National Forest

Recreation Setting Suitability	Alt. A	Alt. B	Alt. C	Alt. D	Alts. E and F	Alts. E-Modified and E-Modified Departure
Developed recreation	7,110	7,700	7,700	7,700	7,700	7,700
Dispersed backcountry motor vehicle	1,315,800	1,324,600	611,300	1,335,400	1,182,500	1,263,600
Dispersed backcountry nonmotorized (including wilderness and recommended wilderness areas)	458,000	449,100	1,162,400	438,300	591,200	510,100

Effects from Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F on Developed Recreation

Administrative and recreation sites would be managed the same for all plan revision alternatives. All three National Forests would have slight changes to the developed recreation area allocation. The use of facilities within all three forests was determined to be below capacity, so additional facility construction is not anticipated. However, in certain locations that are particularly popular

or near towns where facilities are not meeting user expectations or use is at full capacity, additional recreation facilities may be constructed in suitable areas.

The Malheur National Forest would increase acres allocated to developed sites and administrative sites (MA 5) for the plan revision alternatives with an overall increase of 1,150 acres. The Umatilla would decrease acres allocated to MA 5 for Alternatives B, C, D, E, and F with an overall decrease of 1,220 acres; and would have an increase of 1,600 acres for Alternatives E-Modified and E-Modified Departure. The Wallowa-Whitman National Forest would have a slight increase in acres allocated to MA 5 for the plan revision alternatives with an overall increase of 590 acres. It is expected that moderate to high use levels will continue to occur at well-maintained and varied recreation sites including campgrounds, picnic areas, boating sites, ski areas, and other developed recreation sites for all plan revision alternatives

Dispersed Backcountry Motor Vehicle Use

Management areas that include a dispersed backcountry motor vehicle recreation setting include MA 3B Backcountry (motorized use) and MA 4A General Forest.

The recreation setting for each national forest results from a composite of multiple factors and elements including the amount of acres allocated to each management area and the specific combination of management areas that comprise each of the four recreation settings. As an example, an alternative that allocates more acres to MA 3B and 4A and fewer acres to MA 3A (nonmotorized use) would have a comparative emphasis on dispersed backcountry motor vehicle recreation. Conversely, an alternative that allocates more acres to MAs 1B and 3A with lesser amounts to MAs 3B and 4A would have a comparative emphasis on dispersed backcountry nonmotorized recreation.

Effects from Alternative A on Dispersed Backcountry Motor Vehicle Use

Alternative A would not change the amount of land allocated to motor vehicle recreation.

For the Malheur National Forest, the amount of land allocated to dispersed backcountry motor vehicle recreation would not change. For dispersed backcountry motor vehicle use, Alternative A allocates more acres for this use compared to Alternative C, but less than Alternatives B, E, E-Modified, E-Modified Departure, F, and D.

For the Umatilla National Forest, the amount of land allocated to dispersed backcountry motor vehicle recreation would not change. For dispersed backcountry motor vehicle use, Alternative A allocates an intermediate amount of acres for this use compared to other alternatives: Alternatives E, E-Modified, E-Modified Departure, F, and C each would allocate fewer acres for this use, and Alternatives D and B would each allocate more.

For the Wallowa-Whitman National Forest, the amount of land allocated to dispersed backcountry motor vehicle recreation would not change. For dispersed backcountry motor vehicle use, Alternative A allocates an intermediate amount of acres for this use compared to other alternatives: Alternatives E, E-Modified, E-Modified Departure, F, and C each would allocate fewer acres for this use, and Alternatives D and B would each allocate more.

Effects from Alternative B on Dispersed Backcountry Motor Vehicle Use

Management areas that would provide a summer motor vehicle backcountry recreation setting component for Alternative B include MAs 3B and 4A, and all three National Forests would have

open route density desired conditions for managing summer motor vehicle recreation in MAs 3B and 4A. Refer to the Access section for a detailed discussion.

All three National Forests would have areas designated suitable for motor vehicle use. This would include areas where recreation is primitive in nature that would be allocated to MA 3B Backcountry (motorized use). The Umatilla and Malheur National Forests would have areas where recreation is primitive in nature and designated unsuitable for motor vehicle use that would be allocated to MA 3A Backcountry (nonmotorized use). The Wallowa-Whitman National Forest does not have a management area equivalent to MA 3A for Alternative B.

Within the Malheur National Forest, Alternative B would allocate an intermediate amount of acres to dispersed backcountry motor vehicle use compared to other alternatives: Alternative D would allocate more acres for this use; Alternatives E, E-Modified, E-Modified Departure and F allocate slightly fewer acres; and Alternatives C and A would each allocate less.

Within the Umatilla National Forest, Alternative B would allocate an intermediate amount of acres to dispersed backcountry motor vehicle use compared to other alternatives: Alternative B would allocate more acres than Alternatives A, E, E-Modified, E-Modified Departure, F, and C, but fewer acres than Alternative D.

Within the Wallowa-Whitman National Forest, Alternative B would allocate an intermediate amount of acres to dispersed backcountry motor vehicle use compared to other alternatives: Alternative B would allocate more acres than Alternatives A, E, E-Modified, E-Modified Departure, F, and C, but fewer acres than Alternatives A and D.

Effects from Alternative C on Dispersed Backcountry Motor Vehicle Use

MA 4A would comprise the summer motor vehicle backcountry recreation setting for Alternative C. All three National Forests would have open route density desired conditions for managing summer motor vehicle recreation in MA 4A. Refer to the Access section for a detailed discussion.

In this alternative, the three National Forests would not have areas designated for motor vehicle recreation that is primitive in nature. There would be no acres allocated to MA 3B as in the other alternatives.

In general, there would be a decrease in area suitable for summer motor vehicle use across the three National Forests in Alternative C. The overall decrease results from the combination of an increase in acres allocated to MA 3A Backcountry (nonmotorized use), no acres allocated to MA 3B Backcountry (motorized use), and an increase of acres allocated to MA 1B, MA 3C, and MA 4C. Additionally, the amount of acres allocated to MA 4A General Forest would be reduced. Alternative C would result in a large increase in area suitable only for summer nonmotorized use and would enhance walking, hiking, horseback riding, and mountain biking opportunities and experiences. Conversely, this alternative would reduce and displace motor vehicle use and activity such as snowmobiling and riding off-highway vehicles or motorcycles.

For all three National Forests, Alternative C would allocate the least amount of acres to dispersed backcountry motor vehicle use compared to other alternatives.

Effects from Alternative D on Dispersed Backcountry Motor Vehicle Use

MAs 3B and 4A would comprise the motor vehicle dispersed and backcountry recreation setting. All three National Forests would have open route density desired conditions for managing

summer motor vehicle recreation in MAs 3B and 4A. Refer to the “Access” section for a detailed discussion. In general, Alternative D would allocate the largest amount of acres to backcountry motor vehicle use across the Blue Mountains national forests, primarily through an increase in acres allocated to MA 4A for each forest and a similar increase in acres allocated to MA 3B. Alternative D would result in a large increase in area suitable for summer motorized vehicle recreation use and would enhance snowmobiling, off-highway vehicle, and motorcycle riding opportunities and experiences. Conversely, this alternative would reduce walking, hiking, horseback riding, mountain biking opportunities, and experiences that emphasize quiet recreation.

For all three National Forests, Alternative D would allocate the most amount of acres to dispersed backcountry motor vehicle use compared to other alternatives.

Effects from Alternatives E and F on Dispersed Backcountry Motor Vehicle Use

MAs 3B and 4A would comprise the motor vehicle dispersed and backcountry recreation setting for Alternatives E and F. All three National Forests would have open route density desired conditions for managing summer motor vehicle recreation in MAs 3B and 4A. Refer to the Access section for a detailed discussion. In general, Alternatives E and F would allocate an intermediate amount of acres to dispersed backcountry motor vehicle use across the Blue Mountains national forests compared to other alternatives.

Within the Malheur National Forest, Alternatives E and F would allocate more acres to dispersed backcountry motor vehicle use compared to Alternatives A, and C, but fewer than Alternatives B, D, E-Modified, and E-Modified Departure.

For both the Umatilla and Wallowa-Whitman National Forests, Alternatives E and F would allocate more acres to dispersed backcountry motor vehicle use compared to Alternative C, but fewer acres than Alternatives A, B, D, E-Modified, and E-Modified Departure.

Effects from Alternatives E-Modified and E-Modified Departure on Dispersed Backcountry Motor Vehicle Use

MAs 3B and 4A would comprise the motor vehicle dispersed and backcountry recreation setting for Alternatives E-Modified and E-Modified Departure. In general, these alternatives would allocate an intermediate amount of acres to dispersed backcountry motor vehicle use across the Blue Mountains national forests compared to other alternatives.

Within the Malheur National Forest, Alternatives E-Modified and E-Modified Departure would allocate more acres to dispersed backcountry motor vehicle use compared to Alternatives A, C, E, and F, but fewer than Alternatives B and D,

For both the Umatilla and Wallowa-Whitman National Forests, Alternatives E-Modified and E-Modified Departure would allocate more acres to dispersed backcountry motor vehicle use compared to Alternative C, E, and F, but fewer acres than Alternatives A, B, and D.

Dispersed Backcountry Nonmotorized and Wilderness Area Recreation

Management areas that comprise a dispersed backcountry nonmotorized recreation setting would primarily include MA 1A Designated Wilderness, MA 1B Preliminary Administratively Recommended Wilderness, MA 3A Backcountry (nonmotorized use), MA 3C Wildlife Corridor, and MA 4C Old Forest. All of these management areas would support and enhance dispersed backcountry nonmotorized use.

Effects from Alternative A on Dispersed Backcountry Nonmotorized and Wilderness Area Recreation

Alternative A would not change the amount of acres allocated to nonmotorized recreation, and there are no allocations to MA 1B Proposed Administratively Recommended Wilderness Areas in this alternative.

Within the Malheur National Forest, the amount of acres allocated to dispersed backcountry nonmotorized recreation would not change. For dispersed backcountry nonmotorized use, Alternative A allocates less acres for this use compared to Alternative C, but more than Alternatives B, D, E, E-Modified, E-Modified Departure, and F.

Within the Umatilla and Wallowa Whitman National Forests, the amount of acres allocated to dispersed backcountry nonmotorized recreation would not change. For dispersed backcountry nonmotorized use, Alternative A allocates an intermediate amount of acres for this use; Alternatives C, E, E-Modified, E-Modified Departure, and F each allocate more acres for this use; and Alternatives B and D each allocate less.

Effects from Alternative B on Dispersed Backcountry Nonmotorized and Wilderness Area Recreation

Management areas that would comprise a summer nonmotorized backcountry recreation setting for Alternative B include MAs 1A, 1B, 1C, and 3A.

For all three National Forests, Alternative B would allocate an intermediate amount of acres to dispersed backcountry nonmotorized recreation use. Alternative D would allocate less acres for this use, and Alternatives A, C, E-Modified, E-Modified Departure, and F would each allocate more acres for this use.

Effects from Alternative C on Dispersed Backcountry Nonmotorized and Wilderness Area Recreation

All three National Forests would have areas designated for nonmotorized recreation in MA 3A Backcountry (nonmotorized use). This alternative also would include allocations to MA 3C Wildlife Corridors to increase habitat connectivity at the landscape level for wildlife and would contribute to providing opportunities for quiet recreation in roaded areas. Additional allocations would include MA 4C Old Forest and MA 1B Preliminary Administratively Recommended Wilderness Areas where motor vehicle use is generally unsuitable (see general suitability matrix table in appendix A). Future site-specific planning and decision-making would need to consider the desired condition for open route density.

Management areas that would comprise a summer nonmotorized dispersed and backcountry recreation setting for Alternative C include MAs 1A, 1B, 1C, 3A, 3C, and 4C.

For all three National Forests, Alternative C would allocate the largest amount of acres to backcountry nonmotorized recreation use compared to the other alternatives. Alternatives A, B, D, E-Modified, E-Modified Departure, and F would each allocate fewer acres for this use.

Effects from Alternative D on Dispersed Backcountry Nonmotorized and Wilderness Area Recreation

MAs 1A and 1C would comprise the nonmotorized backcountry recreation setting. In this alternative, no MA 1B Preliminary Administratively Recommended Wilderness Areas (PARWA) would be designated. See the PARWA section for detailed information.

None of the three National Forests would have areas designated for nonmotorized recreation that is primitive in nature (MA 3A in other alternatives), other than previously designated wilderness areas. All three National Forests would have areas designated for remote motor vehicle experiences in MA 3B Backcountry (motorized use).

For all three National Forests, Alternative D would allocate the least amount of acres to backcountry nonmotorized recreation use compared to the other alternatives. Alternatives A, B, C, E, E-Modified, E-Modified Departure, and F would each allocate more acres for this use.

Effects from Alternatives E and F on Dispersed Backcountry Nonmotorized and Wilderness Area Recreation

MAs 1A, 1B, 1C, and 3A would comprise the nonmotorized backcountry recreation setting for Alternatives E and F.

For all three National Forests, Alternatives E and F would allocate fewer acres to backcountry nonmotorized recreation use compared to Alternative C, but more than Alternatives B, A, and D.

Within the Malheur National Forest, Alternatives E and F would allocate an intermediate amount of acres to backcountry nonmotorized recreation use compared to the other alternatives. Alternatives A and C would allocate more acres for this use, and Alternatives B, D, E-Modified and E-Modified Departure would each allocate less acres for this use.

Within the Umatilla and Wallowa-Whitman National Forests, Alternatives E and F would allocate an intermediate amount of acres to backcountry nonmotorized recreation use compared to the other alternatives. Alternative C would allocate more acres for this use, and Alternatives A, B, D, E-Modified, E-Modified Departure, and F would each allocate less acres for this use.

Effects from Alternatives E-Modified and E-Modified Departure on Dispersed Backcountry Nonmotorized and Wilderness Area Recreation

MAs 1A, 1B, 1C, and 3A would comprise the nonmotorized backcountry recreation setting for Alternatives E-Modified and E-Modified Departure.

Within the Malheur National Forest, Alternatives E-Modified and E-Modified Departure would allocate an intermediate amount of acres to backcountry nonmotorized recreation use compared to the other alternatives. Alternatives A, C, E, and F would each allocate more acres for this use, and Alternatives B and D would each allocate less acres.

Within the Umatilla and Wallowa-Whitman National Forests, Alternatives E-Modified and E-Modified Departure would allocate an intermediate amount of acres to backcountry nonmotorized recreation use compared to the other alternatives. Alternatives C, E and F would each allocate more acres for this use, and Alternatives A, B, and D would each allocate less acres.

Cumulative Effects to Recreation

The cumulative effects analysis timeframe for recreation is 15 years and the spatial bounds are the lands managed by the Blue Mountains national forests and those lands of other ownership that intermix with the three National Forests. Recreational access across the Blue Mountains national forests is likely to be influenced by a variety of factors. The mixed land ownership (State lands, private, Bureau of Land Management) in and around the forests and the continuing management actions taken on these lands will likely continue providing quality recreation opportunities. It is anticipated that population changes, and changes in the types and intensity of recreation, will continue to influence management actions and responses to these changing factors.

The rural counties immediately adjacent to the Blue Mountains national forests have the highest percent visitation, but these areas have the lowest growth rates, and in some cases, population loses. In contrast, the metropolitan centers, with generally further proximity from the National Forests, have a low percent of visitation, but the population is large and growing at a faster rate than the national average. The Umatilla National Forest has the greatest potential for increasing visitation due to the combination of a relatively large rural population, a large metropolitan population, and a growth rate that is higher than the other two forests.

The Blue Mountains National Forests have experienced significant changes in recreation since the forests were first established and conditions continue to change from those identified in the 1990 forest plans. Initially, recreation was light and concentrated in just several popular areas, with few campgrounds or other site development. A major boom in recreation occurred after World War II through the early to mid-1960s, as post-war populations were attracted to the national forest and placed additional demands on the quantity and quality of recreation facilities.

Since the 1970s, interest in and appreciation of the environment has increased national forest recreation visitation and has shifted activities and expectations. Technical advancements in motorized vehicles (all-terrain vehicles, motorcycles, snowmobiles, etc.) allow these types of vehicles to travel many places where they were unable to travel as recently as five years ago. The invention and advancement of the mountain bike has added a summer nonmotorized use that was not a prominent component of the 1990 forest plans. All of these issues, along with several others, have led to more crowded recreation experiences during peak use times, increasing levels and range of demands on natural resources and resource managers, and generated conflicts among the users themselves.

Continuing changes in equipment technology used for recreational purposes on the Blue Mountains national forests will have effects as new uses, or existing uses change the ease or areas where people recreate. These changes in uses may alter the recreational experience in some areas. Those who pursue nonmotorized recreation opportunities, such as hiking or backcountry skiing, will continue to be afforded widespread opportunities to experience activities that exemplify solitude, risk, challenge, and primitive recreation opportunities.

All alternatives emphasize a mix of recreation opportunities providing today's recreationists with reasonable assurances of future motorized and nonmotorized recreational opportunities. Alternatives D and E-Modified Departure may provide more recreation opportunities toward the developed end of the recreation opportunity spectrum classes by accelerating development of the Blue Mountains national forests with a variety of management actions. These actions may also pose short-term impacts to recreation users through management activities, such as increased timber harvest activity, that may create increased traffic on the forest transportation system and intermittent disruptions to forest travelers. Some values such as remoteness, solitude, and

wildlife-related recreation opportunities may be reduced in Alternative D. Alternative C proposes the least amount of forest management, thereby, emphasizing the primitive and semi-primitive classes of recreational opportunities, and potentially reducing developed and motor vehicle oriented recreation opportunities. Alternative B would emphasize a combination of active management and natural processes for restoring the landscape, a combination that would provide balanced opportunities across a recreational spectrum. Similarly, Alternatives E, E-Modified, E-Modified Departure, and F would provide for a combination of recreational opportunities that would improve or enhance the qualities, quantities, and visitor use satisfaction of recreationists.

The Hells Canyon National Recreation Area, under the administration of the Wallowa-Whitman National Forest, contains outstanding recreational and ecologic values and public enjoyment resulting from the ecosystem functions present within the National Recreation Area. The Hells Canyon National Recreation Area Comprehensive Management Plan, a part of the Wallowa-Whitman National Forest 1990 forest plan, includes added protections for these resources as outlined in Section 1 (a) of the Hells Canyon National Recreation Act (P.L. 94-199).

Special Areas

Introduction

Special areas on the National Forests are managed to protect and where appropriate, foster public use and enjoyment of areas with scenic, historical, geological, botanical, zoological, paleontological, or other special characteristics. A special area must possess unusual recreation and/or scientific values, and it would be desirable that these values be available for public study, use, or enjoyment. These areas provide for conservation of representative, unique, or rare ecosystems or ecological components, as well as culturally significant components. Some of these areas provide natural reference areas to represent eco-regions within each state. Management emphasis is primarily focused on protecting or improving, and where appropriate, developing and interpreting the area’s special characteristics for public education and enjoyment.

This section discusses five types of special areas: wild and scenic rivers, municipal watersheds, research natural areas, experimental forest, and special interest areas. Wilderness and recommended wilderness discussions can be found in a separate section.

Acreages for all current special areas has been recalculated since distribution of the proposed action for public scoping—and further refined since releasing the Draft Environmental Impact Statement—by using the latest GIS technology, so although boundaries may not have changed, the acres reported may have. Changes are noted in the alternative discussions.

Special areas are formally designated either by congressional statute or by administrative action. Congressionally designated areas are established through a formal act of Congress, such as wilderness areas, wild and scenic rivers and national recreation areas. Administratively designated areas include research natural areas, and special interest areas such as historic areas, geologic areas, scenic areas, and botanical areas. These areas may be proposed in forest plans but are established through a separate process. Special interest areas exist for the protection and public enjoyment of areas of special characteristics. Once areas have been designated, by either Congress or agencies, the designation does not usually change. Areas recommended or proposed in forest plans may change. The following types of administratively designated areas occur on the Blue Mountains national forests: scenic areas, historical, geological, and botanical areas; research natural areas; municipal watersheds; scenic byways and nationally designated trails.

Many special areas have their own management plans, which supplement the direction in the forest plans. These individual plans will be brought forward as directed in the 1982 Planning Rule: "If, in a particular case, special area authorities require the preparation of a separate special area plan, the direction in any such plan may be incorporated without modification in plans prepared under this subpart" (36 CFR 219.2 (b) (1982).

Changes Made Between the Draft and Final Environmental Impact Statements

Aside from the global changes throughout this environmental impact statement described in the Preface to this document (see Volume 1), the following changes were made specifically to this section:

Revised Forest Plan Content: In response to numerous comments on the Draft Revised Forest Plan and environmental impact statement that expressed concerns regarding the Nez Perce National Historical Trail, additional background sections were included in the MA 2G Nationally Designated Trail description section for the Oregon Trail and Nez Perce National Historic Trails. Two additional Standards were developed and included in Part 3 – Design Criteria that affords additional protections and management direction for these trails.

In response to existing forest plan requirements, additional management area guidelines were developed for those management areas that previously did not have design criteria including Geologic Areas, Historical Areas, Scenic Byways and All-American Roads, Nationally Designated Trails, Scenic Areas, and Developed Sites and Administrative Areas.

Changes to Special Areas: The additional alternatives (Alternative E-Modified and E-Modified Departure) retain special area allocations for the majority of the special areas. Special area changes resulted from additional internal review, new designations resulting from ongoing project implementation, inclusion of updated allocations, and refined mapping. Table 397 below displays the special areas that were modified for the Final Environmental Impact Statement, and the following sections provide additional discussion and analysis for each special area.

Table 397. Summary of special area changes

Special Area Allocation	Special Area Resource Name	Change
Malheur MA 2B Research Natural Areas	Canyon Creek, Dugout Creek, Stinger Creek	Acreage Update/Mapping Correction
Umatilla MA 2A Wild and Scenic Rivers	Desolation Creek	Acreage Update/Mapping Correction
MA 2A Wild and Scenic Rivers	Looking Glass Creek	Mileage Update and Classification Change
MA 2A Wild and Scenic Rivers	South Fork Desolation Creek	Classification Change
MA 2B Research Natural Area	Mill Creek, Pataha Bunchgrass, Wenaha Breaks	Acreage Update/Mapping Correction
MA 2C Botanical Area	Charley Creek	Acreage Update
MA 2C Botanical Area	Karl Urban	Acreage Update/Mapping Correction
MA 2C Botanical Area	Sourdough	Removed
MA 2C Botanical Area	Henry Creek	Proposed

Special Area Allocation	Special Area Resource Name	Change
Wallowa-Whitman MA 2A Wild and Scenic River	East Eagle Creek	Correction in Classification
MA 2A Wild and Scenic River	Lostine River	Correction in Classification
MA 2B Research Natural Areas	Haystack Rock, Johnson, Nebo, Gerald S. Strickler, Vance Knoll	Acreage Update/Mapping Correction
MA 2B Research Natural Areas	Haystack Rock, Horse Pasture Ridge	Established
MA 2C Botanical Areas	Mount Howard East Peak	New
MA 2D Geological Area	Ichthyosaur Site	New
MA 2E Historical Areas	Oregon Trail	New
MA 2E Historical Areas	Sumpter Valley Railroad Main Line	New
MA 2E Historical Areas	Starvation Archaeological Area	New
MA 2E Historical Areas	Camp Carson	New
MA 2E Historical Areas	Ah-Hee Diggings (Granite-Chinese Walls)	New
MA 2E Historical Areas	Dooley Mountain Obsidian Source	New
MA 2E Historical Areas	Reds Horse Ranch/Millard Ranger Station	New

Management Area Designations for All Plan Revision Alternatives

Special areas would be allocated to:

- MA 2A Designated, Eligible, and Suitable Wild and Scenic Rivers
- MA 2B Research Natural Areas
- MA 2C Botanical Areas
- MA 2D Geological Areas
- MA 2E Historical Areas
- MA 2F Scenic Byways and All-American Roads
- MA 2G Nationally Designated Trails
- MA 2H Scenic Areas
- MA 2I Starkey Experimental Forest and Range
- MA 2J Municipal Watersheds

Standards and guidelines specific to these management areas are available in Appendix A. Special area management area allocations are the same throughout all plan revision alternatives and will not be instrumental in displaying the differences between plan revision alternatives.

Overlapping management areas: many special areas overlap with or are contained in other management areas, such as wilderness or riparian management areas. In this event, the more restrictive management direction applies.

MA 2A Designated, Eligible, and Suitable Wild and Scenic Rivers – Affected Environment

Congress enacted the Wild and Scenic Rivers Act in 1968 to preserve certain selected rivers for their free-flowing condition, water quality, and outstandingly remarkable values. The Wild and Scenic Rivers Act (Public Law 90-542) provided contrast to the established national policy of dam and other construction at rivers of the United States. To protect designated rivers' free-flowing character the Federal Energy Regulatory Commission (which licenses nonfederal hydropower projects) is prohibited from licensing construction of dams, water conduits, reservoirs, powerhouses, transmission lines, or other project works on or directly affecting wild and scenic rivers. Other Federal agencies may not assist by loan, grant, and license or otherwise any water resources project that would have a direct and adverse effect on the values for which a river was designated.

The Wild and Scenic Rivers Act directs that each river in the National Wild and Scenic Rivers System (National System) be administered in a manner to protect and enhance a river's outstanding natural and cultural values. It allows existing uses of a river to continue and future uses to be considered, so long as existing or proposed use does not substantially interfere with protecting river values. The Wild and Scenic Rivers Act also directs building partnerships among landowners, river users, Tribes, and all levels of government.

Rivers may be identified for suitability studies by an act of Congress under Section 5(a), or through federal agency-initiated study under Section 5(d)(1). Through these existing authorities, Congress has authorized 144 rivers for study. Section 5(d) (1) directs federal agencies to consider the potential of wild and scenic rivers in their planning processes; and its application has resulted in numerous individual river designations, and state and area-specific legislation.

Methods

The wild and scenic river study process requires making a determination regarding a river's eligibility, classification, and suitability. Eligibility and classification represent an inventory of existing conditions. Eligibility is an evaluation of whether a river is free flowing (without major dams, diversions, or channel modifications) and possesses one or more outstandingly remarkable values. These values should be a unique or exceptional representation for the area studied and must be related to the river or its immediate environment. If found eligible, a river is analyzed as to its current level of development and a preliminary classification determination is made as to whether it should be placed into one of three classes; wild, scenic, or recreational.

As per the Wild and Scenic River Act at 5(d) (1) and Forest Service Manual policy (Forest Service Manual 1924.03) a systematic inventory was completed on the Malheur, Umatilla, and Wallow-Whitman National Forests. Each National Forest's staff examined their rivers and streams for eligibility.

The potential classification of a river found to be eligible is based on the condition of the river and the adjacent lands as they currently exist. Section 2(b) of the Wild and Scenic Rivers Act specifies and defines these terms as follows:

Wild Rivers: Wild river segments are free of impoundments and are generally inaccessible except by trail and or water trail; the shorelines are essentially natural appearing. Signs of human activity, including structures or evidence of resource use, are minimal. Visitors have the opportunity to interact with a natural environment with minimal sights and sounds of other

people. Wild rivers within designated wilderness areas meet the desired condition for MA 1A Congressionally Designated Wilderness Areas.

Scenic Rivers: Scenic river segments are free of impoundments; shorelines and viewing areas are largely natural appearing. Some recreation structures, evidence of timber harvest roads, and other evidence of human activity may be present but do not detract from the near natural appearance and scenic qualities of the immediate environment. A variety of water related recreational opportunities are available. The river may be accessible from roads in some places.

Recreational Rivers: Recreational river segments are free of impoundments and are readily accessible from roads. Some major public use facilities, such as developed campgrounds, administrative buildings, bridges, private residences, and commercial businesses, may be within the corridor. Considerable development and timber harvest may have occurred and may be evident near the river. A range of recreational opportunities is available in settings where visitors are likely to share their recreational experience with other individuals or groups.

The final procedural step, a suitability study, provides the basis for determining whether to recommend a river as part of the National System. A suitability study is designed to answer the following questions:

- Should the river's free-flowing character, water quality, and outstandingly remarkable values be protected; or are one or more other uses important enough to warrant doing otherwise?
- Will the river's free-flowing character, water quality, and outstandingly remarkable values be protected through designation? Is it the best method for protecting the river corridor? In answering these questions, the benefits and impacts of Wild and Scenic rivers designation must be evaluated and alternative protection methods considered.
- Is there a demonstrated commitment to protect the river by any nonfederal entities that may be partially responsible for implementing protective management?

Rivers authorized for suitability studies by Congress are protected under the Wild and Scenic Rivers Act. Section 7(b) prevents the harmful effects of water resources projects. Section 8(b) withdraws public lands from disposition under public land laws. Section 9(b) withdraws locatable minerals from appropriation under mining laws. Section 12(a) directs actions of other Federal agencies to protect river values. These protections last through the suitability study process, including a 3-year period following transmittal of the final suitability study report by the President to Congress. The integrity of the identified classification must also be maintained during the protection period.

The identification of a river as eligible through the forest planning process does not trigger any protections under the Wild and Scenic Rivers Act. To manage the river for its potential inclusion into the National System, the administering agency applies existing authorities (such as the Clean Water Act and Endangered Species Act) to protect its free-flowing character, water quality, outstandingly remarkable values, and preliminary or recommended classification. Rivers identified as eligible are managed to maintain eligibility until suitability is determined.

Designated Rivers

All of the river segments that have been designated as part of the Wild and Scenic Rivers System under the authority of the Wild and Scenic Rivers Act, as amended (1968) and the Omnibus Oregon Wild and Scenic River Act of 1988 (Public Law 100-557) have comprehensive river

management plans in the Blue Mountains national forests. Table 398 lists the designated wild and scenic rivers for each national forest.

Table 398. Designated wild and scenic rivers* for each national forest**

River Name	Wild	Scenic	Recreational	Outstandingly Remarkable Values
Malheur				Scenery, geology, wildlife habitat, history
Malheur River	6.7	7.0	0.0	
North Fork Malheur River	0.0	25.5	0.0	Scenery, geology, wildlife, fisheries
Totals	6.7	32.5	0.0	
Umatilla				Recreation, scenery, wildlife, fisheries
Wenaha River	18.7	2.7	0.15	
Grande Ronde River***	17.4	0.0	1.5	Recreation, fisheries, wildlife
North Fork John Day River***	24.3	10.5	8.9	Scenic, recreation, fisheries, wildlife, cultural
Totals	60.4	13.2	10.55	
Wallowa-Whitman				Fish, recreation, scenery, cultural resources, geology/paleontology
Eagle Creek	4.5	6.0	18.4	
Grande Ronde River***	17.4	0.0	1.5	Recreation, fisheries, wildlife
Joseph Creek	8.6	0.0	0.0	Scenic, recreation, geology, fish, water quality, wildlife, cultural resources
Imnaha River	15.0	0.0	0.0	Scenic, recreation, fisheries, wildlife, historic, botanical, cultural resources
Lostine River	5.0	0.0	11.0	Scenic, recreation, fisheries, wildlife, botanical
Minam River	41.9	0.0	0.0	Scenic, recreation, geology, fisheries, wildlife
North Fork John Day River***	3.5	0.0	6.9	Scenic, recreation, fisheries, wildlife, cultural
North Powder River	0.0	6.4	0.0	Recreation, scenery
Totals	95.9	12.4	37.8	

*Mileages in this table are derived from legislative language and/or the most recent figures reported in river plans (or "Comprehensive River Management Plans").

**Miles within the Hells Canyon National Recreation Area are not included in this table.

*** The Grande Ronde and North Fork John Day rivers are listed above for both the Umatilla and Wallowa-Whitman National Forests as administration is shared. Mileage for the North Fork John Day River is divided within the table to reflect the mileage within and administered by each national forest. The Grande Ronde River is part of the administrative boundary between the Umatilla and Wallowa-Whitman National Forests, and the mileage is displayed equally for each of the National Forests.

Each river's comprehensive river management plan was reviewed for consistency with revised forest plan components, in addition to determining if the comprehensive river management plan direction was protecting the outstandingly remarkable values for each river. The complete review of forest plan components for each river is available in the project record.

In addition, where visitor use management was required to protect outstandingly remarkable values, river managers were consulted to determine if visitation had increased during the life of the comprehensive river management plan. Monitoring records for the 1990 forest plans were

consulted for changes in visitation in wild and scenic rivers corridors. No river segments were identified as having increases in visitor use that were impacting outstandingly remarkable values.

Eligible Rivers

The Wild and Scenic Rivers Act provides specific direction in section 5(d)(1) regarding the identification of potential wild and scenic rivers in Federal agency planning processes. Forest Service policy requires that rivers identified as potential wild and scenic rivers be evaluated as to their eligibility/ineligibility with the finding documented in the forest plan (Land and Resource Management Planning Handbook, Forest Service Handbook 1909.12, Chapter 80 – Wild and Scenic River Evaluation).

A river is defined by the Wild and Scenic Rivers Act (P.L. 90-542, as amended) as, “a flowing body of water or estuary or a section, portion, or tributary thereof, including rivers, streams, creeks, runs, kills, rills, and small lakes.” The National Wild and Scenic Rivers System: Guidelines for Eligibility, Classification and Management of River Areas (FR vol. 47, no. 173, 9/7/1982, Interagency Guidelines), also allows the consideration of intermittent rivers as eligible, if the volume of flow is sufficient to sustain or complement the outstandingly remarkable values identified within a river segment.

For each ranger district, the Forest Service created an eligibility inventory (located in the project record) as to whether a river is free flowing and possesses one or more outstandingly remarkable value(s). The following eligibility criteria were used to foster greater consistency within the agency and other Federal river-administering agencies. They are intended to set minimum thresholds to establish outstandingly remarkable values and are illustrative and not all-inclusive.

1. **Scenic:** The landscape elements of landform, vegetation, water, color, and related factors result in notable or exemplary visual features and/or attractions. When analyzing scenic values, additional factors such as seasonal variations in vegetation, scale of cultural modifications, and the length of time negative intrusions are viewed may be considered. Scenery and visual attractions may be highly diverse over the majority of the river or river segment.
2. **Recreational:** Recreational opportunities are, or have the potential to be, unique enough to attract visitors from outside of the region of comparison. Visitors are willing to travel long distances to use the river resources for recreational purposes. River-related opportunities could include, but are not limited to, sightseeing, wildlife observation, camping, photography, hiking, fishing, hunting, and boating/rafting.
3. **Geological:** The river or the area within the river corridor contains an example(s) of a geologic feature, process, or phenomena that is rare, unusual, or unique to the region of comparison. The feature(s) may be in an unusually active stage of development, represent a “textbook” example and/or represent a unique or rare combination of geologic features (erosional, volcanic, glacial and other geologic structures).
4. **Fish:** Fish values may be judged on the relative merits of either fish populations or habitat, or a combination of these river-related conditions.
    a. Populations: The river is nationally or regionally an important producer of resident and/or anadromous fish species. Of particular significance is the presence of wild stocks and/or Federal or state listed or candidate threatened, endangered and sensitive species. Diversity of species is an important consideration and by itself could lead to a determination of outstandingly remarkable.

   b. Habitat: The river provides exceptionally high quality habitat for fish species indigenous to the region of comparison. Of particular significance is habitat for wild stocks and/or Federal or state listed or candidate threatened, endangered and sensitive species. Diversity of habitats is an important consideration and could, in itself, lead to a determination of outstandingly remarkable.

5. **Wildlife:** Wildlife values may be judged on the relative merits of either wildlife populations or habitat, or a combination of these conditions.

   a. Populations: The river or area within the river corridor contains nationally or regionally important populations of indigenous wildlife species. Of particular significance are species considered to be unique or populations of Federal or state listed or candidate, threatened, endangered, and sensitive species. Diversity of species is an important consideration and could, in itself, lead to a determination of outstandingly remarkable.

   b. Habitat: The river or area within the river corridor provides exceptionally high quality habitat for wildlife of national or regional significance, or may provide unique habitat or a critical link in habitat conditions for Federal or state listed or candidate threatened, endangered and sensitive species. Contiguous habitat conditions are such that the biological needs of the species are met. Diversity of habitats is an important consideration and could, in itself, lead to a determination of outstandingly remarkable.

6. **Cultural:** The river, or area within the river corridor, contains important evidence of occupation or use by humans. Sites may have national or regional importance for interpreting history or prehistory.

   a. Prehistoric: The river or area within the river corridor contains a site(s) where there is evidence of occupation or use by Native Americans. Sites must have rare or unusual characteristics or exceptional human-interest value(s). Sites may have national or regional importance for interpreting prehistory; may be rare and represent an area where a culture or cultural period was first identified and described; may have been used concurrently by two or more cultural groups; or may have been used by cultural groups for rare or sacred purposes.

   b. Historic: The river or area within the river corridor contains a site(s) or feature(s) associated with a significant event, an important person, or a cultural activity of the past that was rare, unusual or one-of-kind in the region. A historic site(s) and/or feature(s) in most cases are 50 years old or older.

7. **Other Values:** While no specific national evaluation guidelines have been developed for the “other similar values” category, assessments of additional river-related values consistent with the foregoing guidance may be developed, including, but not limited to, hydrologic, paleontological, ecologic and botanic resources.

The potential classification of a river found to be eligible is based on the condition of the river and the adjacent lands as they currently exist. The Wild and Scenic Rivers Act specifies three classification categories for eligible rivers: wild rivers, scenic rivers, and recreational rivers. Section 2(b) of the Act defines each category (see “Affected Environment – MA 2A Designated, Eligible, and Suitable Wild and Scenic Rivers” section in Chapter 3 of the Draft Environmental Impact Statement for definitions of each classification). The following table lists the eligible wild and scenic rivers for each national forest.

Table 399. Eligible wild and scenic rivers for each national forest

River Name	Wild	Scenic	Recreational	Outstandingly Remarkable Values
Malheur Lake Creek	3.3	0.0	0.0	Scenery, geological, botanical
Umatilla Bear Creek	4.6	0.0	0.0	Fisheries
Butte-West Fork Creek	13.9	0.0	0.0	Scenery
Desolation Creek	0.0	0.0	21.5	Recreation, botanical
Lookingglass Creek	0.0	7.9	0.0	Hydrological
North Fork Desolation Creek	0.0	0.0	6.8	Botanical
North and South Fork Wenaha River	26.3	0.0	0.0	Scenery, fisheries, botanical
Sheep Creek (in Washington)	0.0	0.0	0.5	Scenery, botanical
South Fork Desolation Creek	0.0	8.9	0.0	Fisheries, botanical
Tucannon River	9.1	4.6	8.7	Recreation, fisheries, cultural, botanical
Totals	**53.9**	**21.4**	**37.5**	
Wallowa-Whitman Big Sheep Creek	10.0		39.1	Recreation, fisheries, cultural
Dutch Flat Creek/Van Patton Creek*	5.3	0.0	0.0	Scenery, recreation, geological, hydrological, botanical
East Eagle Creek*	9.0	0.0	6.6	Scenery, recreation, fisheries, geological, cultural
Five Points Creek*	0.0	12.1	0.0	Scenery, fisheries, wildlife
Killamacue/Rock Creek	10.2	8.6	0.0	Scenery, recreation, geologic, botanical
North Fork Catherine Creek	11.1	0.0	2.6	Scenery, recreation, fisheries, wildlife
Swamp Creek	9.2	0.0	7.6	Fisheries, wildlife, cultural
Upper Grande Ronde River	11.7	0.0	18.0	Recreation, fisheries, wildlife, cultural
Totals	**66.5**	**20.7**	**73.9**	
Total All	**123.7**	**42.1**	**111.4**	

* These rivers have been determined suitable in Dutch Flat Creek, Killamacue Creek and Rock Creek Wild and Scenic River Study Report (1996) and Wild and Scenic River Study Report and Final Legislative Environmental Impact Statement for Eight Rivers (1997).

Suitable Rivers

The final step in the river assessment process is the determination of suitability. This step provides the basis for the determination of which rivers to recommend to Congress as components of the National Wild and Scenic Rivers System. Suitability addresses two questions:

1. What is the best use of the river corridor? Should the outstanding values be fully protected, or are one or more other uses important enough to warrant not maintaining the river's free-flow or fully protecting identified values?

2. Assuming the values are to be protected, what is the best method to protect the river corridor? Wild and Scenic River designation is one approach. In answering this question, the benefits and impacts of Wild and Scenic River designation must be evaluated and alternative protection methods considered.

A suitability study to assess the potential inclusion of a river within the wild and scenic river designation is conducted and considers the following questions:

- Should the river's free-flowing character, water quality, and outstandingly remarkable values be protected; or are one or more other uses important enough to warrant doing otherwise?
- Will the river's free-flowing character, water quality, and outstandingly remarkable values be protected through designation? Is it the best method for protecting the river corridor? In answering these questions, the benefits and impacts of Wild and Scenic rivers designation must be evaluated and alternative protection methods considered.
- Is there a demonstrated commitment to protect the river by any nonfederal entities that may be partially responsible for implementing protective management?

The Forest Service completed two environmental impact statements on the suitability for 11 eligible river segments within the Wallowa-Whitman National Forest. The Wild and Scenic River Study Report and Final Legislative Environmental Impact Statement for Eight Rivers (1997), and Dutch Flat Creek, Killamacue Creek and Rock Creek Wild and Scenic River Study Report (1996) recommended 3 of the 11 rivers as suitable. These two documents will be used to complete the suitability process for Dutch Flat Creek, East Eagle Creek, and Five Points Creek. Table 400 lists the suitable wild and scenic rivers for the Wallowa-Whitman National Forest.

As provided in the Wild and Scenic River Act, Sections 4(a) and 5(c), the following factors were considered and documented as a basis for the suitability determination for each river in the suitability environmental impact statements:

1. Characteristics, which do or do not make the area a worthy addition to the national system
2. The current status of land ownership and use in the area
3. The reasonably foreseeable potential uses of the land and water that would be enhanced, foreclosed, or curtailed if the area were included in the system
4. The Federal agency that will administer the area, should it be added to the system
5. The extent to which the agency proposes that administration of the river, including the costs thereof, be shared by state and local agencies
6. The estimated cost to the United States of acquiring necessary lands and interests in land and of administering the area, should it be added to the system
7. A determination of the degree to which the state or its political subdivisions might participate in the preservation and administration of the river, should it be proposed for inclusion in the system
8. State/local government’s ability to manage and protect the outstandingly remarkable values on non-Federal lands
9. The consistency of designation with other agency plans, programs or policies
10. Support or opposition to designation
11. Contribution to river system or basin integrity

12. Potential for water resources development
13. Contribution to other regional objectives/needs

The Blue Mountains forest plan revision will not include a suitability analysis for all rivers that have been determined eligible. Only the 11 rivers considered in the two Environmental Impact Statements for the Wallowa-Whitman National Forest were analyzed and are discussed here. When a suitability recommendation is deferred, the forest plan must provide management direction for protecting the outstandingly remarkable values until a suitability recommendation is reached. To provide realistic protection, the appropriate classification for each segment of each eligible river has been established and is listed by river segment with classification in Table 400.

Table 400. Suitable wild and scenic rivers Wallowa-Whitman National Forest*

River Name	Wild	Scenic	Recreational	Outstandingly Remarkable Values
Dutch Flat Creek	5.3	0	0	Scenery, recreation, geological, hydrological, botanical
East Eagle Creek	9.0	0	6.6	Scenery, recreation, fisheries, hydrological, geological, cultural
Five Points Creek	0	12.1	0	Scenery, fisheries, wildlife
Totals	**14.3**	**12.1**	**6.6**	

*These rivers have been determined suitable in Dutch Flat Creek, Killamacue Creek and Rock Creek Wild and Scenic River Study Report (1996) and Wild and Scenic River Study Report and Final Legislative EIS for Eight Rivers (1997).

MA 2A Designated, Eligible, and Suitable Wild and Scenic Rivers – Environmental Consequences

Effects from Alternative A (No-action Alternative)

For this alternative, management direction from the management plans that were written for each of the designated wild and scenic rivers remains in place. For this alternative, no additional rivers would be added as eligible.

For Alternative A only those rivers already designated by Congress as part of the Wild and Scenic Rivers System are included in MA 2A. There are 10,807 acres in this management area within the Malheur National Forest, 6,926 acres within the Umatilla National Forest, and 21,936 acres within the Wallowa-Whitman National Forest.

While the eligible rivers in listed in Appendix A must be managed to retain their eligibility, they will be managed under their current management area designations that vary by national forest set by the 1990 forest plans.

Effects from Alternatives B and C

For these alternatives, MA 2A includes congressionally designated rivers, and those rivers that have been determined to be eligible for designation and warrant further study that may lead to suitability, and ultimately to congressional designation. Management direction from the management plans that were written for each of the designated wild and scenic rivers remains in place. There would be 12,100 acres in this management area within the Malheur National, 44,400 acres within the Umatilla National Forest, and 88,400 acres within the Wallowa Whitman National Forest.

Effects from Alternatives D, E, E-Modified, E-Modified Departure, and F

Malheur and Umatilla National Forests

For these alternatives, MA 2A includes congressionally designated rivers and those rivers that have been determined to be eligible for designation and warrant further study that may lead to suitability, and ultimately to congressional designation. Management direction from the management plans that were written for each of the designated wild and scenic rivers remains in place. MA 2A acres would be the same as Alternatives B and C for the Malheur National Forest at 12,100 acres and the Umatilla National Forest at 44,400 acres.

Wallowa-Whitman National Forest

For these alternatives, MA 2A includes congressionally designated rivers and those rivers that have been determined to be suitable as components of the National Wild and Scenic River System. The environmental impact statements associated with the three rivers listed as suitable will serve as the environmental documentations needed to request congressional review of the suitability determination. MA 2A would be 52,900 acres for the Wallowa-Whitman National Forest. For Alternatives D, E, E-Modified, E-Modified Departure, and F, the eight rivers identified as not suitable for National Wild and Scenic River System designation would be considered ineligible. This finding is documented in the Wild and Scenic River Study Report and Final Legislative Environmental Impact Statement. Please refer the management area maps for the locations of MA 2A for each of the alternatives.

Specific Management Direction for MA 2A

Standards and guidelines for MA 2A are available in Appendix A. Some are specific to particular rivers or river segments due to a correlation with the comprehensive river management plan for that river and are being incorporated from those plans for all alternatives.

MA 2B Research Natural Areas – Affected Environment

Research natural areas are natural areas established by Federal agencies. For the Blue Mountains national forests, the Pacific Northwest Research Natural Area Committee oversees the criteria and process for designating and managing these areas in conjunction with the Natural Heritage Programs of the states of Oregon and Washington.

Research natural areas form a network of ecological reserves for research and education purposes and for the maintenance of biodiversity. The purposes of research natural areas are to: (1) preserve examples of all significant natural ecosystems for comparison with those influenced by man, (2) provide educational and research areas for ecological and environmental studies, and (3) preserve gene pools of typical and endangered plants and animals.

Federal agencies identify areas that have unrepresented plant associations or other elements identified in the Oregon or Washington Natural Area Plan. These areas are evaluated by staff, boundaries are proposed, alternatives are examined, and a site and its boundaries are selected through the planning process. An establishment record is created for each research natural area. These reports include the justification for establishment, legal boundary descriptions, maps, distinguishing ecological features, environmental analyses, and management issues and guidelines. Research natural areas become officially established once an establishment record is completed and signed by the regional forester with concurrence from the Forest Service Pacific Northwest Research Station director.

Research, study, observation, monitoring, and educational activities that are nondestructive and nonmanipulative are generally allowed within research natural areas. While research natural areas are generally unsuitable for livestock grazing, some incidental use by livestock could occur within these areas as administrative boundaries are typically not fenced.

Established and proposed research natural areas within the Blue Mountains national forests are displayed in Table 401.

MA 2B Research Natural Areas – Environmental Consequences

Effects from Alternative A (No-action Alternative)

For this alternative, no new proposed research natural areas would be allocated to MA 2B (see Table 401 for research natural area acres). The forest plan would not recognize additional areas for their special or unique characteristics. These areas would continue to be managed as part of their current management area allocations, which may or may not protect the characteristics for which the additional proposed research natural areas are designated.

Table 401. Acres of research natural areas in each alternative for the Malheur National Forest

Research Natural Area Name	Alt. A	Alts. B, C, D, E, E-Modified, E-Modified Departure, and F	Status	Change
Baldy Mountain	2,591	3,861	Proposed	Boundary update
Canyon Creek	738	736	Established	NA
Dixie Butte	86	335	Proposed	Boundary update
Dry Mountain	2,260	2,260	Established	NA
Dugout Creek*	908	911	Established	NA
Shaketable	375	385	Established	Boundary update
Silver Creek	802	802	Proposed	NA
Stinger Creek	354	1,664	Proposed	Boundary update
Strawberry Mountain	0	107	Proposed	New
Totals	**8,114**	11,061		

Table 402. Acres of research natural areas in each alternative for the Umatilla National Forest

Research Natural Area Name	Alt. A	Alts. B, C, D, E, E-Modified, E-Modified Departure, and F	Status	Change
Birch Creek Cove	411	411	Proposed	NA
Kahler Creek Butte (formerly Kelly Creek Butte)	84	84	Proposed	NA
Mill Creek	7,702	7,424	Proposed	Boundary Update**
Pataha Bunchgrass	63	67	Established	NA
Rainbow Creek	570	570	Established	NA
Vinegar Hill	424	424	Proposed	NA
Wenaha Breaks (formerly Elk Flats-Wenaha Breaks)	1,970	1,971	Established	Boundary update
Totals	**11,224**	10,951		

Table 403. Acres of research natural areas in each alternative for the Wallowa-Whitman National Forest

Research Natural Area Name	Alt. A	Alts. B, C, D, E, E-Modified, E-Modified Departure, and F	Status	Change
Clear Creek Ridge	0	637	Proposed	New
Craig Mountain Lake	172	172	Proposed	NA
Glacier Lake	102	102	Proposed	NA
Haystack Rock	425	418	Established	NA
Horse Pasture Ridge	338	338	Established	NA
Indian Creek	1,003	1,003	Established	NA
Charlie Grier Johnson Jr. (formerly Cougar Meadow)	131	130	Proposed	Name change
Lake Fork*	224	224	Proposed	Boundary update
Mount Joseph	705	705	Proposed	NA
Nebo*	0	1,697	Proposed	New
Point Prominence	365	365	Proposed	NA
Standley	0	742	Proposed	New
Gerald S. Strickler (formerly Government Meadow)	195	190	Established	Name change
Sturgill	0	139	Proposed	New
Tenderfoot Basin	0	891	Proposed	New
Vance Knoll	190	189	Established	NA
West Razz Lake	47	47	Proposed	NA
Totals	**3,897**	7,989		

* The Lake Fork and Nebo proposed research natural areas are partially in the Hells Canyon National Recreation Area. Acreage only for the portions outside the national recreation area is displayed in this table.

** This research natural area is also a designated watershed.

Effects from Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F

The total acres of research natural areas would increase within the Malheur and Wallowa-Whitman National Forests as displayed in the following tables. Acres of research natural areas within the Umatilla National Forest would have a slight decrease. Refer to the following discussion for the rationale for the proposed changes.

Additional Proposed Research Natural Areas for Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F

Since the approval of the existing forest plans, Forest Service ecologists have formally proposed additional research natural areas to help fill missing ecological representations in the natural areas network as published by the Natural Heritage Programs of Oregon and Washington. The proposed areas are each listed below along with a brief description of the area's resource and values.

Malheur National Forest

Strawberry Mountain: this proposed research natural area would serve as the representative for whitebark pine in the southern Blue Mountains.

Umatilla National Forest

No new research natural areas are proposed.

Wallowa-Whitman National Forest

Clear Creek Ridge: this proposed research natural area contains green fescue communities of high value to future research.

Nebo: this proposed research natural area in the Eagle Cap Wilderness is the site of historic benchmark areas for early grazing studies in the Tenderfoot Basin. Since 1938, the green fescue communities in this proposed research natural area have been relatively unimpacted from domestic grazing. The area contains extensive green fescue grasslands in relatively late seral stages.

Standley: this proposed research natural area was prominent in early rangeland sampling and investigation into green fescue use and succession. It continues to provide permanent monitoring opportunities.

Sturgill: this proposed research natural area contains green fescue communities of high value to future research.

Tenderfoot Basin: this proposed research natural area is another historic area of early rangeland sampling and investigation into green fescue community use and succession.

Acreage Changes for Proposed and Established Research Natural Areas for Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F

Malheur National Forest

Baldy Mountain: This proposed research natural area would be increased from 2,591 to 3,861 acres. The boundaries have been modified to include the complete range of ecological significant serpentine plant communities on Baldy Mountain.

Dixie Butte: This proposed research natural area would be increased from 86 to 335 acres. The boundaries have been modified to encompass the spatial extent of a nonforested vegetation mosaic of subalpine shrub steppe and grassland plant communities.

Stinger Creek: This proposed research natural area would increase from 354 to 1,664 acres to include sagebrush scabland/dry pine-mountain mahogany mosaic that is needed for the ponderosa pine-mountain mahogany element.

Umatilla National Forest

Mill Creek: this proposed research natural area would decrease from 7,702 acres to 7,424 acres. The boundaries have been modified to exclude existing National Forest System roads from the southwest portion of the proposed research natural area.

Wallowa-Whitman National Forest

No acreage changes are proposed.

Effects from Research Natural Area Designation for Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F

Research natural areas listed in Table 401 through Table 403 are either established or proposed, as identified in the "Status" attribute column. Of the proposed research natural areas, there is

additional distinction between those proposed research natural areas that were included in the 1990s forest plans—and have yet to be formally designated—and those proposed after the 1990 forest plans that too have yet to be formally designated.

The research natural areas that were proposed and included in the 1990 forest plans as candidate research natural areas have been managed to preserve their unique values and qualities. These areas have been managed to exhibit natural conditions with minimal human intervention, and to maintain prevalent ecological processes. A change from proposed status to designated status for those research natural areas included in the 1990 forest plans would have no effect on either the research natural area itself or surrounding area. Previous management actions conserved the research natural area's unique value and characteristics; and those past management objectives align with the current management allocation to MA 2B. It is expected that formal designation will not have any effect on those lands within the proposed research natural areas or the surrounding area.

The research natural areas that have since been proposed subsequent to the 1990 forest plans represent new, unique areas and the effects of allocation to MA 2B are discussed below by forest.

Malheur National Forest

Nine research natural areas are listed for the Malheur National Forest (Table 401). Of this total, four are formally designated through establishment records, and five are proposed. Of the five that are proposed, four were included in the 1990 forest plan as candidate research natural areas, where the areas were subsequently managed to conserve the natural qualities and characteristics that make them eligible for inclusion in the research natural area program.

The remaining proposed research natural area, Strawberry Mountain, would serve as the representative for whitebark pine in the southern Blue Mountains. The proposed research natural area is situated wholly within the designated Strawberry Mountain Wilderness. It is expected that changing the research natural area's status from proposed to designated would have no effects on the lands contained within the proposed research natural area or to the surrounding area. Both areas would continue to be managed to conserve their respective unique qualities within the framework of the forest plan and adhere to standards and guidelines for all alternatives.

Umatilla National Forest

Seven research natural areas are listed for the Umatilla National Forest (see Table 402 above). Of this total, three are formally designated through establishment records, and four are proposed. All four of the proposed research natural areas were included in the 1990 forest plan as candidate research natural areas. As noted above for the Malheur National Forest, it is expected that changing the research natural areas' status from proposed to designated (through formal designation) would have no effects on the lands contained within the proposed research natural area or the surrounding areas. Past management of these proposed research natural areas would align with the management objectives and standards and guidelines presented in the current forest plan revision.

Wallowa-Whitman National Forest

Seventeen research natural areas are listed for the Wallowa-Whitman National Forest (see Table 403). Of this total, 5 are formally designated, and the remaining 14 are proposed. Of the 12 that are proposed, 7 were included in the 1990 forest plan as candidate research natural areas, where

the areas were subsequently managed to conserve the natural qualities and characteristics that make them eligible for inclusion in the research natural area program.

The remaining five proposed research natural areas were proposed after the 1990 forest plan, and each is described below.

Clear Creek Ridge: This proposed research natural area is situated along the southern boundary of the Eagle Cap Wilderness; only a relatively small, northern portion of the proposed research natural area overlaps with the designated wilderness. For Alternatives B, D, E, E-Modified, E-Modified Departure, and F the management area surrounding the proposed research natural area would be comprised of MA 3B (Backcountry—motorized use). For Alternative C, the proposed research natural area would be entirely contained within MA 1B, preliminary administratively recommended wilderness. For all plan revision alternatives, formal designation of the proposed research natural area would likely have no effect, as the lands contained within the proposed research natural area and the surrounding area are generally managed to conserve these special and unique features for which the area is eligible.

Nebo: This proposed research natural area is situated partially within the Eagle Cap Wilderness (MA 1A), partially within the Hells Canyon National Recreation Area (outside of the current Plan Area), and partially within general forest allocation (MA 4A). For Alternatives B and C, the land management allocations located along the northern portion of the proposed research natural area would be MA 2A, designated and eligible wild and scenic river. For Alternatives D, E, E-Modified, E-Modified Departure, and F the surrounding allocation would be comprised of general forest (MA 4A). For all alternatives, formal designation of the proposed research natural area would likely have no effect, as the lands contained within the proposed research natural area are managed to conserve these special and unique features for which the area is eligible, and the surrounding areas are similarly managed to preserve these conditions.

Standley, Sturgill, and Tenderfoot Basin: These proposed research natural areas are situated wholly within the designated Eagle Cap Wilderness. It is expected that changing the research natural area status from proposed to designated would have no effect on the lands contained within the proposed research natural areas or to the surrounding area. These three areas would continue to be managed to conserve their respected unique qualities through forest plan standards and guidelines that would preserve these natural features.

MA 2C Botanical Areas – Affected Environment

Botanical areas have special values and unique natural characteristics. Botanical areas contain specimens, groups of plant colonies, or plant communities that are significant because of form, color occurrence, habitat location, life history, ecology, variety, or other features. While botanical areas are generally unsuitable for livestock grazing, some incidental use by livestock could occur within these areas as administrative boundaries typically are not fenced. The network of established or proposed botanical areas on the National Forests of the Blue Mountains is displayed in Table 404.

MA 2C Botanical Areas – Environmental Consequences

Effects from Alternative A (No-action Alternative)

The Malheur National Forest has two botanical areas totaling 123 acres. The Umatilla National Forest has four botanical areas totaling 827 acres. There are no botanical areas within the Wallowa-Whitman National Forest.

For this alternative, no new botanical areas would be allocated to MA 2C and boundaries would not change. Botanical areas proposed for Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F would continue to be managed as part of their current management area allocations, which vary by national forest.

Effects from Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F

Botanical areas within the Malheur National Forest would not change; however, updated mapping recognizes that the Cedar Grove Botanical Area is 116 acres instead of the currently reported 94 acres (Table 404). For the Umatilla National Forest, a reduction would be made to the Charley Creek Botanical Area and three new botanical areas would be added). Botanical areas within the Wallowa-Whitman National Forest would increase 1,102 acres from the addition of the newly designated Mount Howard East Peak National Natural Landmark.

Table 404. Botanical areas (acres) for each alternative for the Malheur National Forest

Botanical Area	Alt. A	Alts. B, C, D, E, E-Modified, E-Modified Departure, and F	Change
Malheur National Forest			NA
Fergy Spruce Grove	29	29	
Cedar Grove	94	116	Acreage Update / Mapping Correction
Totals	123	145	**NA**
Umatilla National Forest			Increased acres to protect unique values
Charley Creek	50	41	
Ruckel Junction	5	9	Acreage Update / Mapping Correction
Karl Urban	500	499	Name changed from Sheep Creek Falls Botanical Area
Shimmiehorn Canyon	197	197	NA
Sourdough	0	0	NA
Henry Creek	0	34	Proposed
Farr Meadows	0	12	Proposed
Elk Flats Meadow	0	97	Proposed
Teal Springs	61	0	Removed
Woodward Campground	15	0	Removed
Totals	827	890	**NA**
Wallowa-Whitman National Forest			New
Mount Howard East Peak*	0	1,012	

*Mount Howard-East Peak is a National Natural Landmark.
NA = not applicable

MA 2D Geological Areas – Affected Environment

Geological areas have outstanding formations or unique geological features of the earth's development, such as caves, fossils, dikes, cliffs, or faults. These areas are protected or enhanced, and where appropriate, public use and enjoyment is fostered. The established geological areas within the Blue Mountains national forests are displayed in Table 405.

Table 405. Geological areas (acres) for each alternative for each national forest

Geological Area Name	Alt. A	Alts. B, C, D, E, E-Modified, E-Modified Departure, and F	Change
Malheur National Forest			
Magone Lake	40	185	Mapping correction
Tex Bridge	1	1	NA
Totals	**41**	**186**	**NA**
Umatilla National Forest			
Big Sink	416	416	NA
Wallowa-Whitman National Forest			
Ichthyosaur Site	0	5	New

MA 2D Geological Areas – Environmental Consequences

Effects from Alternative A (No-action Alternative)

The Malheur National Forest has two geological areas totaling 41 acres. The Umatilla National Forest has one geological area totaling 416 acres. There are no geological areas within the Wallowa-Whitman National Forest.

For this alternative, no new geological areas would be allocated to MA 2D and boundaries would not change. The geological areas proposed under Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F would continue to be managed as part of their current management area allocations, which vary by national forest.

Effects from Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F

Geological areas within the Malheur National Forest would increase to 185 acres at Magone Lake, and would include Tex Bridge at 1 acre, for a total of 186 acres. No changes are proposed for Big Sink Geological Area within the Umatilla National Forest. Geological areas within the Wallowa-Whitman National Forest would increase to 5 acres with the addition of the Ichthyosaur site.

MA 2E Historical Areas – Affected Environment

Historical areas have historic sites, buildings, or objects of significance. The network of established historical areas within the Blue Mountains national forests is displayed in the following table. Historical areas are protected or enhanced, and, where appropriate, public use and enjoyment is fostered.

MA 2E Historical Areas – Environmental Consequences

Effects from Alternative A (No-action Alternative)

The Sumpter Valley Railroad site (13 acres) is the only historical areas within the Malheur National Forest. There are three historical areas totaling 1,173 acres within Umatilla National Forest. There are no designated historical areas within the Wallowa-Whitman National Forest.

Table 406. Historical areas (acres) for each alternative for each national forest

Historical Area Name	Alt. A	Alts. B, C, D, E, E-Modified, E-Modified Departure, and F	Change
Malheur National Forest			
Sumpter Valley Railroad	13	444	NA
Depression ERA CCC Buildings	0	11	New
Early and Intermediate Period Buildings	0	4	New
Historic Lookouts	0	7	New
Malheur Headwaters National Register District	0	4,950	New
Camas Oven Site	0	10	New
Pre-Mazama Site	0	10	New
Arch Rock Site	0	2	New
Historic Mining Districts	0	598	New
Obsidian Source Archaeological Complex	0	28,000	New
Totals	**13**	**34,036**	NA
Umatilla National Forest			
Greenhorn	90	90	NA
Olive Lake-Fremont Powerhouse	1,000	1,000	NA
Target Meadows	83	83	NA
Totals	**1,173**	**1,173**	NA
Wallowa-Whitman National Forest			
Oregon Trail	0	318	New
Sumpter Valley Railroad Main Line	0	913	New
Starvation Archaeological Area	0	260	New
Camp Carson	0	117	New
Ah-Hee Diggings (Granite-Chinese Walls)	0	40	New
Dooley Mountain Obsidian Source	0	616	New
Reds Horse Ranch/Millard Ranger Station	0	44	New
Totals	0	2,308	NA

Effects from Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F

Nine additional historical areas and an increase to the Sumpter Valley Railroad historical area within the Malheur National Forest, totaling 34,036 acres, are proposed for allocation to MA 2E. No changes are proposed for the Umatilla National Forest. Seven historical areas within the Wallowa-Whitman National Forest, totaling 2,308 acres, are proposed for allocation to MA 2E.

MA 2F Scenic Byways and All-American Roads – Affected Environment

The national scenic byways program is a part of the U.S. Department of Transportation. The program is a grassroots, collaborative effort established to help recognize, preserve, and enhance selected roads throughout the United States. The U.S. Secretary of Transportation recognizes

certain roads as all-American roads or national scenic byways based on one or more archeological, cultural, historic, natural, recreational, or scenic quality.

The purpose of the scenic byways program is to create a distinctive collection of American roads, their stories, and treasured places by creating a unique travel experience and enhanced local quality of life through efforts to preserve, protect, interpret, and promote the intrinsic qualities of designated byways. Table 407 displays the miles of designated scenic byways within the Blue Mountains national forests. Each of the scenic byways has additional mileage outside of national forest boundaries.

Table 407. Scenic byways within the Blue Mountains national forests (miles) for each alternative for each national forest

Scenic Byway Name	Alt. A	Alts. B, C, D, E, E-Modified, E-Modified Departure, and F	Change
Malheur National Forest			
Journey Through Time Scenic Byway	0	13	New
Umatilla National Forest			
Blue Mountains Scenic Byway	0	48	New
Elkhorn Scenic Byway	0	3	New
Totals	**0**	**51**	
Wallowa-Whitman National Forest			
Blue Mountains Scenic Byway	0	2	New
Hells Canyon Scenic Byway*	0	10	New
Journey Through Time Scenic Byway	0	21	New
Elkhorn Scenic Byway	0	52	New
Totals	**0**	**85**	

* A portion of the Hells Canyon Scenic Byway, an All-American Road, is within the Hells Canyon National Recreation Area.

MA 2F Scenic Byways and All-American Roads – Environmental Consequences

Effects from Alternative A (No-action Alternative)

There are no scenic byways or all-American roads allocations in the 1990 forest plans.

For this alternative, no scenic byways or all-American roads would be allocated to MA 2F. The scenic byways and all-American road allocations proposed for Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F would continue to be managed as part of their current management area allocations, which vary by national forest.

Effects from Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F

Thirteen miles of scenic byways within the Malheur National Forest, 51 miles of scenic byways within the Umatilla National Forest, and 85 miles of scenic byways and all-American roads within the Wallowa-Whitman National Forest would be allocated to MA 2F. Through collaboration with multiple partners, a management plan has been developed for each scenic byway.

Additional routes may be located outside the National Forests boundary that are recognized locally by state or local governments, or by special interest groups for scenic or historic values, but are not recognized by forest plans.

MA 2G Nationally Designated Trails – Affected Environment

The National Trails System Act (1968) authorized the creation of a national trail system comprised of National Recreation Trails, National Scenic Trails, and National Historic Trails. These trails are included in the listing of specially designated areas because of their scenic, recreational, and historic value. Table 408 displays the trails that are designated within the Malheur, Umatilla, and Wallowa-Whitman National Forests.

Table 408. Designated trails (miles) for each alternative for each national forest

Trail Name	Alt. A	Alts. B, C, D, E, E-Modified, E-Modified Departure, and F	Change
Malheur National Forest			
Arch Rock National Recreation Trail	0	0.3	New
Cedar Grove National Recreation Trail	0	1	New
Malheur River National Recreation Trail	0	8	New
Totals	**0**	**9.3**	
Umatilla National Forest			
Jubilee Lake National Recreation Trail	0	3	New
North Fork John Day National Recreation Trail	0	22.9	New
South Winom Creek National Recreation Trail	0	4	New
Totals	**0**	**29.9**	
Wallowa-Whitman National Forest			
Elkhorn Crest National Recreation Trail	0	23	New
High Wallowa National Recreation Trail	0	2	New
Oregon Trail National Historic Trail	0	8.3	New
Totals	**0**	**33.3**	

* The following designated trails are within the HCNRA and are not included in this table: Nez Perce-Nee Me Poo National Historic Trail and the Western Rim/Summit Ridge, Heaven's Gate, and Snake River National Recreation Trails.

MA 2G Nationally Designated Trails – Environmental Consequences

Effects from Alternative A (No-action Alternative)

No nationally designated trails are recognized by the 1990 forest plans.

For this alternative, no nationally designated trails would be allocated to MA 2G. The nationally designated trails proposed for allocation to MA 2G in Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F would continue to be managed as part of their current management area allocations, which vary by national forest.

Effects from Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F

The 9.3 miles of nationally designated trails within the Malheur National Forest, 29.9 miles of nationally designated trails within the Umatilla National Forest, and 33.3 miles of nationally designated trails within the Wallowa-Whitman National Forest would be allocated to MA 2G.

MA 2H Scenic Areas – Affected Environment

Scenic areas are places of natural variety where unique physical characteristics provide pleasing views and dispersed recreational opportunities. Scenic areas are designated to protect or enhance, and, where appropriate, foster public use and enjoyment of areas with special landscapes noted for their natural beauty. There are three designated scenic areas within the National Forests of the Blue Mountains. The network of established scenic areas on the National Forests of the Blue Mountains is displayed in Table 409. There are no designated scenic areas in the Wallowa-Whitman National Forest.

Table 409. Scenic areas (acres) for each alternative for the Malheur and Umatilla National Forests*

Name	Alt. A	Alts. B, C, D, E, E-Modified, E-Modified Departure, and F	Change	Establishment
Malheur National Forest Vinegar Hill-Indian Rock Scenic Area	12,835	12,385	NA	Established in 1966 by regional forester
Silver Creek Scenic Area	1,572	1,572	Proposed	Proposed established scenic area addition
Totals	**14,407**	**14,407**		
Umatilla National Forest Vinegar Hill-Indian Rock Scenic Area	21,956	21,956	NA	Established in 1966 by regional forester and amended in 1978 by adding the Desolation Unit
Grande Ronde Scenic Area	9,158	9,158	NA	Established in 1979 by regional forester
Totals	**31,114**	**31,114**		

* There are no designated scenic areas in the Wallowa-Whitman National Forest.

MA 2H Scenic Areas – Environmental Consequences

Effects from Alternative A (No-action Alternative)

The Vinegar Hill-Indian Rock Scenic Area is the only scenic area within the Malheur National Forest (12,800 acres). The scenic area is shared with the Umatilla National Forest (21,900 acres). In addition, Silver Creek Scenic Area, a 1,500 acre area that was treated in the past forest plan as a scenic area, has not had formal designation. The Umatilla has an additional 9,100-acre scenic area. There are no scenic areas within the Wallowa-Whitman National Forest.

For this alternative, no new scenic areas will be allocated to MA 2H and boundaries would not change. The scenic areas proposed for Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F would continue to be managed as part of their current management area allocations, which vary by national forest.

Effects from Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F

The Silver Creek Scenic Area within the Malheur National Forest would be formally designated. No additional scenic areas are proposed for the Umatilla and Wallowa-Whitman National Forests.

MA 2I Starkey Experimental Forest and Range – Affected Environment

The Starkey Experimental Forest and Range (Starkey) was established in 1940. It is managed to support existing research projects and to provide for future research needs. Experimental forests and ranges were established explicitly to conduct research benefitting and supporting National Forest System management. Management treatments on experimental forests and ranges generally are integrated with and support research projects. The national network of experimental forests and ranges, a land base authorized by Congress and designated by the Chiefs of the Forest Service over the last 100 years, provides sites where long-term ecological research can be maintained. Experimental forests and ranges are living laboratories where scientists not only make discoveries but also demonstrate relevant research results for cooperators and stakeholders. They provide opportunities to conduct the innovative research that will be required for sound management of future landscapes.

Starkey is a world-class research facility and a primary field location for long-term, operational scale scientific studies of the effects of management activities on ungulates and wildlife, as well as effects of deer, elk, and cattle on ecosystem process and function. Scientists conducting research at Starkey have generated many publications that have been instrumental in providing managers with defensible options and best management practices for managing roads and traffic, including off-road recreation, livestock grazing, and fuel treatments in relation to ungulates. Significant, long-term research on interactions between livestock and wild ungulates began in 1989, through a joint wildlife research project conducted by the Oregon Department of Fish and Wildlife, Oregon State University, and the Forest Service.

The Station Director will review and concur with management activities proposed within this Experimental Forest and Range.

MA 2I Starkey Experimental Forest and Range – Environmental Consequences

Effects from Alternative A (No-action Alternative)

There are no experimental forests on either the Malheur National Forest or the Umatilla National Forest. The Starkey Experimental Forest and Range is the only experimental forest within the Blue Mountains national forest and is located wholly within the Wallowa-Whitman National Forest (30,500 acres).

For this alternative, no new experimental forests would be allocated to MA 2I and boundaries would not change. The experimental forest areas proposed for Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F would continue to be managed as part of their current management area allocations.

Effects from Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F

The Starkey Experimental Forest and Range within the Wallowa-Whitman National Forest would continue to be allocated to MA 2I. No additional experimental forests are proposed for the Malheur and Umatilla National Forests.

MA 2J Municipal Watersheds – Affected Environment

A municipal watershed is an area that serves a public water system as defined by the Safe Drinking Water Act. The act applies to systems that provide water for human consumption, have at least 15 service connections, or regularly provide water to at least 25 people. The act was

amended in 1996 to require source water protection zones for groundwater wells that provide water for public use. The act regulates both community and non-community water systems.

Six communities in the Blue Mountains national forests have water systems that derive water supplies directly from National Forest System lands (see Table 410).

The definition of municipal watershed in current Forest Service regulations does not include communities served by a well or confined groundwater unaffected by Forest Service activities. However, the Safe Drinking Water Act of 1974 was amended in 1996 to require source water protection zones for groundwater wells that provide water for municipal use. Designation of municipal watersheds recognizes the need to protect public water supplies. Municipal watersheds may be managed for multiple uses so long as management activities do not degrade water quality.

Management of some municipal water supply watersheds is subject to the terms of existing agreements between the Secretary of Agriculture and the respective cities.

In general, management of the municipal watersheds displayed in Table 410 is guided by existing agreements between the individual cities and either the Secretary of Agriculture or the Forest Service. Actions that could degrade water quality are either prohibited or subject to approval by the respective city. For some communities, wells outside the Forests are the primary water source, but wellhead protection zones may extend onto National Forest System lands.

Table 410. Designated municipal watersheds for each national forest

Watershed	Alt. A	Alts. B, C, D, E, E-Modified, E-Modified Departure, and F	Change	Establishment
Malheur National Forest Long Creek Municipal Watershed	256	256	NA	1937 Special Use Permit
Byram Gulch Municipal Watershed	279	279	NA	1926 Special Use Permit
Total	**535**	**535**	NA	NA
Umatilla National Forest Mill Creek Municipal Watershed	20,300	20,300	NA	1918 Agreement between Secretary of Agriculture and City of Walla Walla
Total	**20,300**	**20,300**	NA	NA
Wallowa-Whitman National Forest Baker City Municipal Watershed (multiple streams)	9,322	9,322	NA	1912 Agreement with Department of Agriculture
La Grande City Municipal Watershed (Beaver Creek)	15,161	15,161	NA	1935 Agreement with Department of Agriculture
Total	**24,483**	**24,483**	NA	NA
Total All	**45,318**	**45,318**	NA	NA

In addition to the municipal watersheds listed in Table 410, nine communities in Oregon have watersheds or water sources located on or adjacent to National Forest System lands that should be protected to meet state source-water protection guidelines.

Within the Malheur National Forest:

- The town of Seneca uses two groundwater wells for its public water supply. The wellhead protection zones for these wells may include National Forest System lands and require protection under the Safe Drinking Water Act. Prairie City obtains its water supply from Dixie Creek, which originates on National Forest System lands.
- Twelve additional sites, including campgrounds, administrative sites, and one privately owned site provide water for public use and are regulated by provisions of the Safe Drinking Water Act as non-community water systems.

Within the Umatilla National Forest:

- The North Fork Umatilla River was designated as the municipal water supply for the city of Pendleton by the Oregon State Legislature in 1941. In 1984, the area was designated as a wilderness area and the city has since transferred its water intake to a point on the Umatilla River near the city of Pendleton.

Within the Wallowa-Whitman National Forest:

- The town of Granite has a water intake on National Forest System lands operating under special use permit. A wellhead protection zone for a groundwater well extends onto National Forest System lands.
- The town of Halfway has municipal water rights on National Forest System lands but has converted the water system to groundwater sources on city-owned lands.
- The upper Wallowa River, including Wallowa Lake, is designated by the Oregon Department of Environmental Quality as the municipal water supply for the city of Joseph. The city water intake is located near the outlet of Wallowa Lake and is not on National Forest System lands.
- The city of Sumpter has a water intake operating under special use permit on National Forest System lands. The watershed is designated by Oregon Department of Environmental Quality as a municipal water supply.
- The city of Wallowa owns municipal water rights on National Forest System lands (Bear Creek), but has converted its water system to groundwater sources on city-owned lands.
- The communities of Richland and Greenhorn obtain their water from surface sources originating on National Forest System lands.
- Fifteen additional sites within the Wallowa-Whitman National Forest, primarily campgrounds and administrative sites, provide water for human consumption and are regulated under the authority of the Safe Drinking Water Act as non-community water systems.

MA 2J Municipal Watersheds – Environmental Consequences

Effects from Alternative A (No-action Alternative)

There are two municipal watersheds within the Malheur National Forest totaling 535 acres. The Umatilla National Forest has one municipal watershed totaling 20,300 acres. There are two municipal watersheds within the Wallowa-Whitman National Forest totaling 24,483 acres.

For this alternative, no new municipal watersheds will be allocated to MA 2J and boundaries would not change. The municipal watersheds proposed for Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F would continue to be managed as part of their current management area allocations.

Effects from Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F

The municipal watersheds within the Malheur, Umatilla, and Wallowa-Whitman National Forests would continue to be allocated to MA 2J. No additional municipal watersheds are proposed for the Malheur, Umatilla, and Wallowa-Whitman National Forests.

Scenery Resources

Introduction

The Blue Mountains National Forests are known for their scenic value. The scenic qualities of the National Forests represent the backdrop for the communities of the Blue Mountains and encompass the attractive recreational aspects of living in eastern Oregon and southeastern Washington. Management activities on the Malheur, Umatilla, and Wallowa-Whitman National Forests play an integral part in the high quality scenery of this region. The high quality scenic environment is vital to the communities that use and support the Blue Mountains national forests.

Scenic attributes, including identifiable patterns, distinct color, texture, form, and elements, such as aspen stands and rock formations, are derived from specific geological features and functioning ecosystems. These features provide a scenic identity and image that is valued as a backdrop for the activities and experiences that create memories and meet expectations of national forest visitors (Bacon et al. 1974, Ryan 2005). People visiting or recreating in the area value the scenery of the Blue Mountains for the natural beauty, undeveloped or undisturbed scenes, and rural western setting. There are many opportunities to view historic structures and traditional uses, such as historic mining operations, ranching facilities, Civilian Conservation Corp structures, pole fences, and historic ditches. Mountains and canyons present dynamic vertical change, plant communities that are present at differing elevations, and geological features, such as rock outcrops and peaks. Water features create strong visual images that are highly valued. All of these attributes and many more create patterns and mosaics that contribute to the scenery of the Blue Mountains.

No significant issues related to scenic resources were identified during scoping or the need for change analysis process. At least one-third of the landscape within the Blue Mountains national forests has been altered by human developments and activities as well as recent disturbance events, such as large-scale fires. Some of these alterations are not obvious to casual viewers because the landscapes present natural-appearing scenery. This is especially true when looking at some of the vegetation conditions that have resulted from fire exclusion and prescribed fire. Another third of the national forest landscape is less altered by human activities, but roads and trails allow visitors access to these areas. The area seems to be predominately natural and is very attractive to visitors given the easy access. The last third is largely natural and is designated wilderness areas or backcountry. Access to these areas is much more difficult, but the visitor is rewarded with scenery that appears natural. Although many backcountry areas have been manipulated by fire suppression and may have looked much different had natural processes prevailed, it would be hard for the casual observer to detect this. Results from the 2014 National Visitor Use Monitoring (NVUM) report indicates that visitors found scenery and condition of the

environment to be highly satisfactory and highly important to their recreation experience across the Blue Mountains.

Changes Made Between the Draft and Final Environmental Impact Statements

Aside from the global changes throughout this environmental impact statement described in the Preface to this document (see Volume 1), the following changes were made specifically to this section: updated analysis to include two additional alternatives (Alternative E-Modified and Alternative E-Modified Departure).

Scenery Resources – Affected Environment

The Forest Service provides for scenery management as outlined in the Forest Service Directive System under the Forest Service Manual Chapter 2380 – Landscape Management. The directives result from complying with statutory requirements including the Multiple-Use Sustained Yield Act of 1960, The Forest and Rangeland Renewable Resources Planning Act of 1974, as amended by the National Forest Management Act of 1976, and rules at Title 36 of the Code of Federal Regulations, Part 219, among others.

In 1995, the Forest Service developed an updated version of its direction for scenery management (called the Visual Management System), introducing the Scenery Management System. The Scenery Management System is consistent with the procedures and guidance outlined in the Agriculture Handbook 701 (1995), “Landscape Aesthetics: A Handbook for Scenery Management.” These systems are both structured to primarily emphasize “natural appearing” scenery, but the Scenery Management System recognizes positive scenic values associated with some human modified (cultural) features and settings that are valued for their scenic influence. The Scenery Management System allows for a “seamless” analysis and conservation of aesthetic values, and provides a systematic approach for determining the relative value and importance of scenery on National Forest System lands.

Scenery is inventoried and placed into one of seven scenic classes with Scenic Class 1 being highly valued and distinctive and Scenic Class 7 being nondistinctive and valued the least (see Scenic Class maps in Appendix G). Each classification is determined by the combination of scenic attractiveness, viewpoint, viewing distance, and duration along with the frequency and/or number of viewers (USDA Forest Service 1995). Determining this range of scenic classes allows managers to understand the social acceptability of any change in scenery. Table 411 shows the distribution of scenic classes as inventoried for each National Forest.

Table 411. Percent distribution of scenic classes for each national forest

Scenic Class	Malheur	Umatilla	Wallowa-Whitman
1	15	37	46
2	45	37	36
3	32	18	14
4	2	1	NA
5	6	7	4
6	NA	NA	NA
7	NA	NA	NA

Scenic integrity and scenic stability are two indicators used to evaluate the condition of scenery resources. Scenic integrity addresses human caused disturbances and development that may detract from the desired scenic character. Scenic stability addresses the relative stability of the valued scenic character and its scenic attributes. More in-depth scenic character descriptions can be found in the project record.

Scenic Integrity

Scenic integrity was developed to measure the amount of visual disturbance that contrasts with and/or detracts from the natural or socially valued appearance in a landscape. It provides a contextual measurement of the presence, intensity and dominance of human-caused visual disturbances in the landscape. Within a natural resources setting, these visual disturbances can include timber harvest, road construction, mining, utilities development, recreation facilities, ski areas, and other special uses.

Scenic integrity also applies to extreme scenic disturbances caused by natural events whenever these events are outside the historical range of variability for the landscape. Large scale or high intensity events, such as catastrophic wildfires, insect and disease disturbances, and wind or ice storms that exceed the historical range of variability are considered negative visual disturbances to the valued landscape character, while those within the historical range of variability are considered neutral elements.

Scenic Integrity Levels

Very High Integrity

The valued scenery appears natural or unaltered. Only minute visual disturbances to the valued scenery, if any, are present. This level should be achieved immediately upon project completion.

High Integrity

The valued scenery appears natural or unaltered, yet visual disturbances are present; however, they remain unnoticed because they repeat the form, line, color, texture, pattern, and scale of the valued scenery. This level should be achieved as soon after project completion as possible but within no more than 3 years.

Moderate Integrity

The valued scenery appears slightly altered. Noticeable disturbances are minor and visually subordinate to the valued scenery because they repeat its form, line, color, texture, pattern, and scale. This level should be achieved as soon after project completion as possible but within no more than 3 years.

Low Integrity

The valued scenery appears moderately altered. Visual disturbances are co-dominant with the valued scenery and may create a focal point of moderate contrast. Disturbances may reflect, introduce, or borrow valued scenery attributes from outside the landscape being viewed (such as the size, shape, edge effect, and pattern of natural openings, vegetative type changes, or socially valued architectural styles). Scenery attributes borrowed from outside the viewed landscape appear compatible with or complimentary to those within. This level should be achieved as soon after project completion as possible but within no more than 3 years.

Very Low Integrity

The valued scenery appears heavily altered. Disturbances dominate the valued scenery being viewed, and may only slightly borrow from, or reflect valued scenery attributes within or beyond the viewed landscape (due to their size, shape, edge effect, and pattern). However, disturbances must be shaped and blended with the natural terrain (primary landforms) so they do not dominate the overall composition when viewed as background (beyond 3 to 4 miles). Such disturbances might include unnatural appearing openings, roads, landform modifications, or structures. This level applies immediately upon project completion and should only be used to inventory existing scenic integrity and never as a management objective.

No Integrity

The valued scenery appears extremely altered. Disturbances are excessively dominant regardless of viewing distance and borrow little if any form, line, color, texture, pattern or scale from the valued scenery within or near the vicinity. Scenery at the unsuitable level needs rehabilitation. This level should only be used to inventory existing scenic integrity and never as a management objective.

The existing impacts to scenic integrity are predominately related to harvest activities dating before 1980. More recent harvest activities were designed to blend with natural appearing settings. Within the Blue Mountains, approximately15 percent of the landscape has a low or very low scenic integrity level, where visual disturbances detract from the valued scenic character. An example is a vegetation harvest unit that appears distinctly geometric and unnatural. Twenty percent of the area has a moderate scenic integrity level, where openings in the vegetation are largely out of scale, but the edges are blended or shaped in a manner that appears somewhat natural. Fifty percent of the area has a high scenic integrity level, and 12 percent very high, where the valued scenic character appears intact with no detracting visual disturbances. The distribution of existing scenic integrity level for each national forest is summarized in the following tables.

Table 412. Distribution of existing scenic integrity levels (percent) for the Malheur National Forest

Existing Integrity Level	Scenic Class 1	Scenic Class 2	Scenic Class 3	Scenic Class 4	Scenic Class 5	Scenic Class 6	Scenic Class 7
High	41	54	56	75	68	88	75
Low	15	11	8	4	8	11	19
Moderate	28	34	35	20	24	1	5
Very high	16	0	0	0	0	0	0
Very low	1	2	1	0	1	0	0

Table 413. Distribution of existing scenic integrity levels (percent) for the Umatilla National Forest

Existing Integrity Level	Scenic Class 1	Scenic Class 2	Scenic Class 3	Scenic Class 4	Scenic Class 5	Scenic Class 6	Scenic Class 7
High	31	60	53	55	54	75	69
Low	15	17	15	9	13	4	3
Moderate	6	21	30	35	31	20	27
Very high	47	0	0	0	0	0	0
Very low	1	2	2	1	2	1	1

Table 414. Distribution of existing scenic integrity levels (percent) for the Wallowa-Whitman National Forest

Existing Integrity Level	Scenic Class 1	Scenic Class 2	Scenic Class 3	Scenic Class 4	Scenic Class 5	Scenic Class 6	Scenic Class 7
High	44	62	63	73	64	93	86
Low	11	13	13	8	15	2	2
Moderate	12	24	23	18	21	5	12
Very high	33	0	0	0	0	0	0
Very low	0	0	0	0	0	0	0

Scenic Stability

Scenic stability is an indicator for the Scenery Management System, introduced to specifically identify the ecological sustainability of the valued landscape character and its scenery attributes. Scenic stability is a consideration of the condition of valued scenery attributes identified in the landscape character description and an evaluation of whether or not the condition is within the historical range of variability. The condition of forested vegetation-related scenery attributes (pattern, stand structure and density, species composition) gives an indication of whether or not the ecosystem is functioning properly and if the vegetation components of valued scenery can be sustained. If conditions are outside of historical range of variability or are trending away from that range, then it is likely that scenery attributes are at greater risk of decline or loss. The distribution of existing scenic stability classes are summarized in Table 415 for each national forest.

Table 415. Existing scenic stability by scenic class for each national forest (percent)

National Forest and Scenic Class	Unstable	Very Low	Low	Moderate	High	Very High
MAL - 1	0.54	10.75	39.27	49.17	0.19	0.08
UMA - 1	0.42	18.98	44.66	35.92	0.03	0.00
WAW - 1	0.05	3.92	14.10	79.70	2.22	0.00
MAL - 2	0.03	9.84	50.66	39.41	0.05	0.00
UMA - 2	0.30	12.92	47.36	39.39	0.04	0.00
WAW - 2	0.01	5.03	18.15	75.65	1.16	0.00
MAL - 3	0.02	9.79	61.66	28.50	0.03	0.00
UMA - 3	0.11	21.22	50.05	28.61	0.00	0.00
WAW - 3	0.02	9.66	17.17	70.65	2.50	0.00
MAL - 4	0.05	15.57	54.85	29.43	0.10	0.01
UMA - 4	0.48	14.26	38.21	46.74	0.26	0.05
WAW - 4	0.27	0.55	4.23	84.12	9.95	0.89
MAL - 5	0.17	19.10	57.81	22.75	0.17	0.00
UMA - 5	0.03	24.44	44.11	31.27	0.15	0.00
WAW - 5	0.08	10.43	12.38	77.03	0.07	0.00
WAW - 6	0.00	0.00	0.00	82.66	14.59	2.75
WAW - 7	0.14	0.00	0.00	73.89	16.48	9.49

MAL = Malheur, UMA = Umatilla; WAW = Wallowa-Whitman

Scenic Stability Levels

Very High Stability

All dominant and minor scenery attributes of the valued landscape character are present and are likely to be sustained.

High Stability

All dominant scenery attributes of the valued landscape character are present and are likely to be sustained. However, there may be scenery attribute conditions and ecosystem stressors that present a low risk to the sustainability of dominant scenery attributes.

Moderate Stability

Most dominant scenery attributes of the valued landscape character are present and are likely to be sustained; a few may have been lost or are in serious decline.

Low Stability

Some dominant scenery attributes of the valued landscape character are present and are likely to be sustained. Known scenery attribute conditions and ecosystem stressors may seriously threaten or have already eliminated the others.

Very Low Stability

Most dominant scenery attributes of the valued landscape character are seriously threatened or absent due to their conditions and ecosystem stressors, and are not likely to be sustained. The few that remain may be moderately threatened but are likely to be sustained.

No Stability

All dominant scenery attributes of the valued landscape character are absent or seriously threatened by their conditions and ecosystem stressors. None are likely to be sustained, except relatively permanent attributes, such as landforms.

In many areas, the long-term stability of scenery resources is at risk of large scale impacts due to conditions exacerbated by past wildfire suppression and timber harvest practices. The resultant conditions of homogenous, overly dense forests of non-fire-resistant species heavily laden with fuels put scenery resources at risk from uncharacteristically large, stand-replacing wildfires, and insect and disease disturbances.

Sixty-three percent of scenic class 1 has moderate scenic stability, meaning that most dominant scenery attributes of the valued landscape are present but there are conditions that pose a threat to the stability of the attributes, such as large-scale wildfire or disturbance from insects and diseases. Less than 5 percent of scenic class 1 has high scenic stability, meaning that the dominant scenery attributes are present and are likely to be sustained.

Scenery Resources – Environmental Consequences

Effects from Alternative A (No-action Alternative)

Alternative A would continue the current visual management system including visual quality objectives (VQO) described in National Forest Landscape Management, Volumes 1 and 2. The 1990 forest plans include requirements (standards and guidelines) for limitations on the types and

size of activities in visual foreground retention and partial retention areas. These areas are generally located along well-traveled routes.

No visual resource management areas are designated within the Wallowa-Whitman National Forest. The Umatilla National Forest includes several management areas (A3 and A4) where the visual resource is emphasized. The Malheur National Forest has approximately 190,000 acres allocated to MA 14 Visual Corridors.

No desired conditions would exist for scenic stability, which would likely result in larger areas of National Forest System land in lower scenic stability than the plan revision alternatives.

Effects Common to Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F

The desired conditions for scenery are common to all plan revision alternatives. All plan revision alternatives would result in activities on National Forest System land meeting the desired condition for scenic classes and provide the visual landscape character attributes that are valued by local communities and visitors of the National Forests.

Table 416 summarizes the desired condition for scenic integrity and stability. While all alternatives would meet desired conditions there would be variation in the speed at which scenic stability and integrity desired conditions are met as well as in the long and short term effects. Acres of vegetation management are the primary variable that would result in different effects between the plan revision alternatives.

Specific scenic attributes are preserved across the Blue Mountains national forests. These include:

- Aspen groves
- Open ponderosa pine stands
- Civilian Conservation Corps era structures
- Historic mining structures
- Rock outcrops
- Water features
- Grassy meadows
- Component of western larch in stands
- Riparian hardwoods
- Herbland/timberland mosaic
- Homesteads
- Deciduous shrubs

Table 416. Scenic integrity levels and scenic stability levels (desired condition)

Scenic Class	Scenic Integrity Levels	Scenic Stability Levels
1	Very high, high	Very high, high
2	Very high, high, moderate	Very high, high, moderate, low
3	Very high, high, moderate	Very high, high, moderate, low
4	High, moderate, low	Very high, high, moderate, low
5	High, moderate, low	Very high, high, moderate, low
6	High, moderate, low	Very high, high, moderate, low
7	High, moderate, low	Very high, high, moderate, low

Effects from Vegetation Management on Scenery Resources

All alternatives include vegetation management. Vegetation management activities that result in conditions outside of the historical range of variability can result in adverse effects to scenic integrity and stability and conditions that do not meet scenery objectives. Lack of vegetation

management can also result in conditions of further departure from the historical range of variability and as such lower scenic stability in the long term. Effects from vegetation management can result in adverse effects in foreground, middle ground, and background viewing distance zones. Short-term effects are typically limited to foreground visibility of vegetation management such as cut faces and tree spacing, which can be mitigated through design and project planning. Associated activities such as logging debris skid trails and landings can result in adverse effects to scenic integrity, primarily when viewed from foreground distances. Vegetation treatments that include burning may result in short-term effects that include patches of blackened forest, scorched tree crowns, hazy skies, and smoke concentrated in some areas. Activities associated with vegetation management can be designed to meet scenic integrity standard in most conditions within 2 to 5 years following implementation.

All plan revision alternatives include guideline SCEN-1, which states that short-term reductions to existing scenic integrity levels should be authorized only when needed to achieve the long-term restoration or rehabilitation of scenic integrity and/or scenic stability.

The majority of short-term impacts to scenic integrity can be mitigated through project design; however, this guideline would allow flexibility to achieve longer term stability in scenic quality. Alternatives with more acres treated to return the forested landscape to historical ranges of variability would result in longer-term stability of the valued landscape characteristics but would likely have more areas of short-term reduction in scenic integrity as viewed from foreground positions. The effects from the alternatives apply to each national forest.

Effects from Vegetation Management on Scenery Resources for Alternatives B, E, E-Modified, E-Modified Departure, and F

The effects of these four alternatives are similar to each other, and the magnitude is in between that of Alternatives C and D for acres treated. The level of vegetation treatment anticipated may result in improved scenic stability conditions in the long term due to the emphasis on reducing fuels and treating vegetation to move it toward the historical range of variability, but at a level less than anticipated for Alternative D. Vegetation management would emphasize active management in the dry forest type, creating more open stands of trees with a park-like appearance. There would be more evidence of logging, including stumps visible from tree removal, skid trails, and debris piles, but at a level less than anticipated for Alternative D.

Effects from Vegetation management on Scenery Resources for Alternative C

Low levels of vegetation management anticipated for this alternative may result in improved scenic integrity conditions in the long term due to the emphasis on nonmotorized use and protection of wilderness characteristics. However, there is indication that this alternative would create a greater fire risk, increasing the likelihood of uncharacteristic wildfire. This alternative would result in larger areas of lower scenic stability than other plan revision alternatives due to larger areas of forest left untreated outside the historical range of variability.

Effects from Vegetation Management on Scenery Resources for Alternatives D and E-Modified Departure

The level of vegetation management anticipated for Alternatives D and E-Modified Departure may result in an improved scenic stability condition in the long term due to the emphasis on reducing fuels and treating vegetation to move it toward the historical range of variability. However, these alternatives may create a more managed and less natural appearing landscape. Vegetation management would emphasize active management in the dry forest type, creating

more open stands of trees with a park-like appearance. There would be more evidence of logging, including stumps visible from tree removal, skid trails, and debris piles.

Long-term effects may include landscapes that appear more as they might have at the turn of the century, reduced brush density, and vistas available because of reduction of vegetation density.

Effects from Other Management Activities

Visual disturbances can include road construction, mining, utilities development, recreation facilities, ski areas, and other special uses. These types of activities generally would not improve scenic integrity or stability in the long term, unlike vegetation management activities. Scenic integrity and stability desired conditions would be common to all plan revision alternatives. The level of development of these activities is anticipated to have negligible variations between alternatives and not to an extent that would result in different scenic integrity or stability. While access is a key issue, little to no new road construction is anticipated for any of the alternatives. All new development would be evaluated at project level planning to achieve scenic integrity and stability desired conditions.

Cumulative Effects

The implementation of the forest plans would result in indirect effects to scenery within the greater region of the Blue Mountains including the surrounding communities and public travel routes off National Forest System land. Effects to scenery would last approximately 30 years, considering lasting effects of implementation of vegetation management activities beyond the anticipated life of the plan. Past actions have created the existing scenic integrity and stability conditions. Areas modified by timber harvest in the 1980s and 1990s may in some cases continue to appear highly managed during the next 10 to 15 years and scenic integrity will remain low to very low in those areas.

Reasonably foreseeable future actions that would affect scenic quality that overlap within the time and space include timber harvests off National Forest System land, wildfire and other disturbances. Timber harvest that would occur on neighboring private, state, and public lands may influence overall scenic integrity within the greater Plan Area. Harvest that would occur in the wildland-urban interface as directed by the National Fire Plan may also add to these effects. Wildfire and other disturbance processes, if large enough in scale and intensity, may result in decreased scenic attractiveness for a few years in those areas affected by the disturbance. Driving for pleasure and other scenery dependent activities could be affected slightly by human disturbance to areas outside the National Forests. Considering the type of activities and distances from communities, the scenic backdrop above the valleys would remain generally unchanged for all alternatives. The long-term effects of implementing the forest plan combined with ongoing and reasonably foreseeable future actions would result in conditions that continue to provide the valued and restorative qualities of the landscape to forest visitors and the surrounding communities.

The Hells Canyon National Recreation Area, under the administration of the Wallowa-Whitman National Forest, contains valued scenic vistas sites. The Hells Canyon National Recreation Area Comprehensive Management Plan, a part of the Wallowa-Whitman National Forest 1990 forest plan, includes added protections for these scenic resources as outlined in Section 7 of the Hells Canyon National Recreation Act (P.L. 94-199). All scenery resources on all three National Forests would be managed in accordance with laws, regulations, and Forest Service policies and management direction.

Heritage Program

Introduction

Humans have inhabited the Blue Mountains for more than 12,000 years. As warming climatic conditions caused glacial retreat and population increased, early hunting and gathering societies diversified. American Indian cultures in the Blue Mountains adapted as needed to environmental fluctuations within a yearly rhythm of seasonal rounds. American Indians established villages along the drainages of major rivers and utilized seasonal camps for hunting, fishing, plant gathering, and other activities. Specific places for fishing, hunting, and gathering became important. Favored areas for berry picking, root gathering, hunting, and collection of other necessary materials offered continuity with the land and affirmed spiritual beliefs.

The Blue Mountains were not pristine wildernesses prior to the arrival of non-Indian emigrants, but ecological systems in which humans had been an active component. Harvest of fish, game, and plant resources was timed to ensure future availability. Plant gathering methods increased the productivity of the soil and increased the yield of food crops. The rivers provided salmon, steelhead, sturgeon, lampreys, suckers, and trout. American Indians employed low-intensity fire as a tool to manage vegetation and enrich forage for grazing for livestock and other large mammals, and to promote growth of berries for human and animal consumption. Fire was also used to signal other Tribes or send warnings, and was used in ceremonial events.

American Indian cultures in the region remained generally stable until the effects of European colonization of North America reached the area as early as 500 years ago. Long before the arrival of non-Indian emigrants in the region, European diseases swept across the area and caused significant population loss and social disruption. Several Tribes adapted the horse into their culture as early as 1700. In the 1850s and 1860s, most Tribes entered into treaties with the United States in which they retained their sovereignty and access to critical resources.

The Lewis and Clark Expedition in 1804 is generally considered the beginning of the historic period in the Blue Mountains. American and Canadian fur trappers followed, and Oregon Trail migration began in the early 1840s. Gold was discovered in the Blue Mountains in the 1860s and Euro-American settlement began in earnest. Mines and settlements required timber, and logging became a big industry in the area in the 1880s. Grazing and farming increased as the population grew. Mining and logging required roads and the beginnings of today's road systems were put in place. Mining and agriculture required water, and ditches were constructed to move it to where it was needed. As the population increased, more people began visiting the National Forests for recreation. In the 1930s, the Civilian Conservation Corps constructed or improved many Forest Service recreation sites in the Blue Mountains. The Forest Service also established many fire lookout towers, along with cabins and other administrative sites.

Understanding the role of humans in past and present ecosystems provides a context for understanding contemporary landscapes and natural resource issues. Cultural resources have local, regional, and national scientific interest and significance, and are elements of worldwide patterns and processes. Beyond scientific value, these sites offer a tangible connection to history and culture as well as a sense of place. Cultural resource sites, objects, and areas have an intrinsic value to people whose ancestors used and occupied the lands. The heritage program ensures that significant archaeological and historical resources are identified, protected, and preserved for the inspiration and benefit of present and future generations. Educational and volunteer projects, such as the Forest Service's Passport in Time program, foster public participation in identifying, understanding and protecting cultural resources.

Changes Made Between the Draft and Final Environmental Impact Statements

Aside from the global changes throughout this environmental impact statement described in the Preface to this document (see Volume 1), the following changes were made specifically to this section:

Revised Forest Plan Content: The desired condition for cultural resources (goal 2.5) was modified to recognize the need for appropriate use and maintenance of historic facilities; and the need for identifying resource types including traditional cultural properties, cultural landscapes, sacred sites, and other culturally significant areas by Tribes and local communities was included.

The resource types considered in Management Area 2E (Historical Areas) were expanded to include both archaeological sites and districts, and to emphasize that existing preservation and management plans for these resources are carried forward in the revised forest plan.

In response to numerous comments on the Draft Revised Forest Plan and Environmental Impact Statement that expressed concerns for increased cultural resource protection, the forestwide guideline for cultural resources was changed to a standard.

Heritage Program – Affected Environment

Cultural resources are categorized into three broad types: prehistoric site, historic site, or traditional cultural property. A prehistoric site is one that was established before the advent of a continuous written record, or before approximately 1800 in this area. A historic site postdates this time. A traditional cultural property is associated with cultural practices or beliefs of a living community, is rooted in that community's history, and is important in maintaining the continuing cultural identity of the community.

Prehistoric and historic sites and traditional cultural properties that are eligible for listing on the National Register of Historic Places (NRHP) are considered historic properties under the National Historic Preservation Act (NHPA) and are managed and protected under that law. Cultural resources for which NRHP eligibility has not yet been determined are managed as historic properties until a determination is completed. The most significant and historic properties can be identified as priority heritage assets and would be proactively monitored and managed.

In order for a cultural resource to be eligible for listing on the NRHP, a district, site, building, structure, or object must meet at least one of four criteria. Sites that qualify for listing include sites:

A. That are associated with events that have made a significant contribution to the broad patterns of our history
B. That are associated with the lives of persons significant in our past
C. That embody the distinctive characteristics of a type, period, or method or construction, or that represent the work of a master, possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction
D. That have yielded, or may be likely to yield, information important in prehistory or history

Sites must also possess integrity of location, design, setting, materials, workmanship, feeling, and/or association.

More than one-third of all cultural resource sites identified on National Forest System lands within Oregon and Washington are located in the Blue Mountains national forests (Table 417).

Prehistoric sites common to the Blue Mountains include quarries, tool manufacturing sites, hunting camps, fishing stations, plant gathering and processing sites, rock art sites, villages and sites resulting from other types of activities. Historic sites in the area include, but are not limited to homesteads, mines, railroads, cabins, corrals, lookout towers, and Forest Service administrative sites. Traditional cultural properties include sites, districts, buildings, structures or objects that are valued by human communities for the role they play in sustaining a community's cultural integrity and could include plant-gathering sites, fishing stations, a rural community or a rodeo ground. The exact number and kind of cultural resources in the Blue Mountains is not known. Additional cultural resources will continue to be discovered and evaluated as surveys are completed for potential management activities.

Educational and volunteer projects, such as the Forest Service's Passport in Time program, foster public participation in identifying, understanding and protecting cultural resources.

Table 417. Identified cultural resource sites within the Blue Mountains national forests

National Forest	All Sites	NRHP Eligible Sites	NRHP Ineligible Sites	Unevaluated Sites	NRHP Listed Sites	Priority Assets	Interpreted Sites
MAL	5,125	2,274	399	2,433	19	207	8
UMA	1,914	691	122	1,100	1	7	3
WAW*	4,377	701	753	2,921	2	6	10

* Does not include sites in the Hells Canyon National Recreation Area.

Heritage Program – Environmental Consequences

Effects Common to All Alternatives

Potential risks to cultural resources include development, public use, looting and vandalism, management activities, timber harvest, cattle grazing, and mining, along with natural processes such as erosion by wind and water, weathering, and wildfire. Cultural resource surveys during the planning phase for site-specific projects and prior to ground disturbance can identify previously unknown cultural resources and require changes to the operating plan that mitigate potential damage. Potential effects to cultural resources from project activities are addressed through project-specific mitigation measures during the project planning process. Although the potential to effect cultural resources always exists, under all alternatives cultural resources would be carefully managed to avoid or mitigate adverse effects whenever possible.

All alternatives would provide management direction for cultural resources in a manner consistent with the laws, executive orders, and regulations listed in Volume 4, Appendix B of this document. Cultural resource inventories are part of the analysis process for management activities and known significant sites are protected during implementation of those activities. Although concerted efforts are made to avoid damaging cultural resources during Federal undertakings or authorized actions, in rare instances inadvertent impacts or damage may occur. Unanticipated indirect effects may occur in some instances, such as providing new or improved access to an area, which increases the potential for illegal collection of artifacts or vandalism, and modifying vegetative cover, which may increase the potential for damage due to erosion or decay.

The Heritage Program will be managed to national standard based on a national forest specific mix of the following seven indicators:

1. A Heritage Program plan would be developed and maintained by each national forest (FSM 2362.3).
2. Lands where cultural resources are most likely to occur would be surveyed (FSM 2363.03, 2363.1).
3. Legacy cultural resources would be evaluated for eligibility for listing on the National Register of Historic Places and historic properties would be nominated for listing (FSM 2363.2, 2364.41).
4. Condition assessments for priority heritage assets, including allocation to the appropriate management category, would be accomplished (FSM 2362.4, 2363.3, 2366).
5. Stewardship activities would preserve, protect, and enhance historic properties (FSM 2364.36, 2364.42).
6. Opportunities for study and appropriate public use of cultural resources including research, traditional use, and interpretation would be provided (FSM 2364.43, 2365.2).
7. Volunteer opportunities would be provided (FSM 2365.2).

By managing the Heritage Program for the Blue Mountains national forests to national standards, the Forest Service will work to ensure that cultural resources are identified and protected for future generations.

Effects Specific to Alternative A (No-action Alternative)

Management Direction

All 1990 forest plans have goals that provide for the identification, protection, interpretation, and management of significant cultural resources consistent with the legal framework described previously. There are no management area allocations specific to cultural resources in any of the 1990 forest plans.

The Malheur National Forest 1990 forest plan includes the historic Sumpter Valley Railroad site in special interest areas along with geologic, botanical, and other unique sites.

The Umatilla National Forest 1990 forest plan includes the Greenhorn area, Olive Lake-Freemont Powerhouse area, and Target Meadows in special interest areas along with botanical areas, viewpoints, and other unique areas.

The Wallowa-Whitman National Forest 1990 forest plan does not recognize historic sites specific to any management area allocation.

Effects from Alternative A

Management direction would continue the inventory, documentation, evaluation, and protection of cultural resources at current levels. Additional sites would continue to be identified as surveys are conducted during project analysis. The cultural resources identified as part of special interest areas would continue to be identified with areas that have other resource values.

Effects Specific to Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F

Management Direction

Historical areas have historic sites, buildings, or objects of significance. The specific areas identified for their historic or prehistoric value would be protected and enhanced, and, where appropriate, public use and enjoyment would be fostered. Historical areas would be added as a management area allocation (MA 2E) under these alternatives.

Effects from Alternatives B, C, D, E, E-Modified, E-Modified Departure, and F

Indirect effects to cultural resources from Alternatives B and F would be similar to Alternative A. Alternatives D and E, F, E-Modified, and E-Modified Departure due to the proposal of more intensive management, would have a greater likelihood of identifying additional sites, but the likelihood that those management activities would damage sites is greater, as described previously. Alternative C, due to the proposal of fewer management activities and likely lower use levels by the public, would have the lowest potential for damaging cultural resources, but also would have the lowest potential for identifying additional sites.

Effects from Other Resource Management Areas

Potential Effects from Aquatic Resources Management on Cultural Resources

Cultural resources generally benefit from management actions that improve the stability and functionality of watersheds. This reduces erosion and stabilizes stream banks. Cultural resources have a high probability of occurrence along streams. Management actions that require ground disturbance or the use of heavy machinery have the potential to adversely affect cultural resources.

All alternatives would allocate miles of riparian area improvement and vary by alternative. Effects to cultural resources from riparian area improvement would be greatest in Alternatives A, B, and D (the least amount of restoration miles), are intermediate for Alternatives E, E-Modified, E-Modified Departure, and F, and are the least for Alternative C (largest amount of restoration). Effects to cultural resources from ground disturbance associated with restoration activities would be reduced, eliminated, or mitigated through project specific protection measures and mitigation.

Potential Effects from Wildfire Management on Cultural Resources

Fire suppression activities have a high potential to adversely affect cultural resources. Fire lines, helicopter landings, camp locations, and other fire suppression actions may adversely affect cultural resources. Wildfires have a high potential to adversely affect historic structures, such as ranches, homesteads, and mining structures. Prehistoric cultural resources, such as rock art, can be damaged by heat and smoke generated by wildfire, as well as by post-fire erosion. Post-fire management activities that promote rapid growth of ground cover can stabilize sites and reduce their visibility, thereby reducing their vulnerability to looting and vandalism.

The location of cultural resources related to vegetation type plays a role in the possible effects to sites. The temperature and duration of fire affects soil temperature, and buried archeological remains may be seriously affected by high temperatures and long fire duration. Fires in grasslands are generally of short duration and cooler temperatures, and have fewer effects. Fires in forested vegetation types are usually more intense and of longer duration than those in grasslands, and have the potential for greater effects.

Wildfire consists of unplanned ignitions. Although the occurrence is unplanned, mitigation measures to reduce the effects to cultural resources include a program of pre-incident survey of potential fuelbreaks and other fire suppression-related activity locations. Where heritage resources are found, programmatic agreement standard protection measures such as project redesign, relocation and monitoring would be used to protect the affected heritage resources. Inventories should also occur on those incident activities not previously inventoried prior to the completion of the incident. Effective treatment measures should be used to rehabilitate fire suppression-related ground disturbance.

Potential Effects from Preliminary Administratively Recommended Wilderness Areas Allocations on Cultural Resources

Wilderness areas are subject to far fewer land management activities than other multiple-use areas. Activities related to recreation use, such as dispersed camping, trail construction and maintenance, and hiking, along with livestock grazing and wildfire, can affect cultural resources in designated wilderness areas, but little other active management takes place in those areas. Few effects to known and unknown cultural resources would take place from these activities.

The majority of new cultural resource sites are identified during archaeological inventories conducted for proposed management activities, the majority of which are conducted in areas located outside of designated wilderness. In wilderness areas, new sites are discovered during inventories that are often conducted for the sole purpose of identifying cultural resources. This type of inventory is generally conducted by the heritage program staff, often with the assistance of volunteers, using dedicated heritage program funds. The frequency and extent of surveys within wilderness is dependent on funding which varies annually, but generally is relatively limited compared to the number of surveys conducted for site-specific projects for identification purposes per Section 106 of the National Historic Preservation Act.

Alternative C would allocate the largest amount of area to preliminary administratively recommended wilderness (MA 1B), followed by Alternatives E and F (equal amounts), then Alternatives E-Modified and E-Modified Departure with slightly less acres than Alternatives E and F, and Alternative B with the least amount. Both Alternatives A and D do not allocate any acreage to MA 1B. In general, alternatives that allocate larger amounts of acreage to MA 1B would conserve cultural resources, but reduce the opportunity for identification, and may increase the potential for wildland fire to affect cultural resources. Conversely, those alternatives with either an intermediate or lesser amount of acreage allocated to MA 1B would still allow for cultural resource conservation achieved through applying cultural resource protection laws and programmatic agreements. The opportunity for identification through project specific undertakings may increase, and effects from wildland fire would likely remain at the same levels through all alternatives.

Potential Effects from Livestock Grazing on Cultural Resources

Domestic livestock can affect both historic and prehistoric cultural resources. Potential impacts include: removal of surface vegetation, compaction or compression of archeological deposits, alteration of soil chemistry, livestock trailing or cutting through archaeological deposits, destruction of historic structures by rubbing or trampling, and breakage of historic and prehistoric artifacts from trampling.

All alternatives would allocate acres suitable for permitted cattle and sheep grazing and vary by alternative. The number of permitted animal unit months also varies by alternative. Effects to

cultural resources from livestock grazing would be greatest in Alternative D, are intermediate for Alternatives A, B, E, E-Modified, E-Modified Departure, and F, and are least for Alternative C.

Potential Effects from Recreation and Access on Cultural Resources

Cultural resource vandalism and looting are potential impacts resulting from access and visitor use. Construction and maintenance of roads, trails, campgrounds, and other developed facilities may also impact cultural resources. Prehistoric and historic cultural resources are often found in optimum locations for developed recreation sites. Dispersed recreation may also impact cultural resources as modern camps are often located on prehistoric sites. Vandalism in the form of target practice or use for firewood often damages historic structures. Interpretation of these sites can reduce the adverse effects from recreation use.

Alternatives that provide for the greatest amount of road maintenance and the highest levels of access would have a greater effect on cultural resources. Effects to cultural resources from recreation and access would be greatest in Alternative D and E-Modified Departure; are intermediate for Alternatives E, E-Modified, and F; are slightly less than intermediate for Alternatives A and B; and are the least for Alternative C.

Potential Effects from Vegetation Management on Cultural Resources

Vegetation management involves ground disturbance ranging from minimal disturbance for some activities, such as noncommercial thinning and reforestation activities, to high disturbance for other activities, such as construction of access roads, skid roads, trails, and landings, and the felling of trees and the skidding of logs. Potential impacts to cultural resources include soil compaction, soil erosion, streambank erosion, surface mixing of soils, and damage to above- and below-ground features. These impacts are reduced, eliminated, or mitigated through project specific protection measures and mitigation.

Alternatives that contribute to the greatest amount of vegetation management would have the greatest potential to effect cultural resources. Effects to cultural resources from vegetation management would be greatest in Alternative D, followed second by Alternative E-Modified Departure. Of the remaining alternatives, Alternative E and Alternative E-Modified would have intermediate effects and both Alternatives F and B are similar and effects would be slightly less than Alternative E. Alternative C would have the least effect.

Cumulative Effects

The cumulative effects analysis area includes all of northeastern Oregon, southeastern Washington, and western Idaho, including all of the Malheur, Umatilla, and Wallowa-Whitman National Forests, and the time period considered was the planning period. The Hells Canyon National Recreation Area, under the administration of the Wallowa-Whitman National Forest, contains thousands of prehistoric sites and historic sites. The Hells Canyon National Recreation Area Comprehensive Management Plan, a part of the Wallowa-Whitman National Forest 1990 forest plan, includes added protections for these sites as outlined in Section 7 of the Hells Canyon National Recreation Act (P.L. 94-199). All historic properties on all three National Forests would be managed in accordance with laws, regulations, executive orders, and Forest Service policies and management direction.

Development of lands not protected by Federal or state cultural resource statutes and regulatory protection could decrease the regional resource base and lead to loss of resources. Cultural resources within the National Forests could increase in value and significance as sites outside the

National Forests are developed or destroyed. Cultural resources are nonrenewable. Cumulative effects could occur through incremental degradation of the resource base on both public and private lands. Identification of significant cultural resource sites on public lands and the preservation and protection of those sites should reduce the downward trend of the cultural resource base and reduce the cumulative effects from management activities across the landscape.

Geology, Mining, Minerals, and Energy

Introduction

Geologic resources in the Blue Mountains include leasable energy minerals, such as oil, natural gas, coal, and geothermal; saleable minerals, such as sand, gravel, and other rocks, used in the construction and landscaping industry; and locatable minerals, such as gold, silver, and other precious and base metals.

Oil and gas resources are known or suspected to occur in a deep sedimentary basin that underlies parts of the Malheur and Wallowa-Whitman National Forests, and all of the Umatilla National Forest. The potential extent of these resources has been estimated on a broad regional scale, but little interest or exploration has taken place to date near or within the National Forest System lands.

Coal deposits are known in the Troy and Flora areas, and west of Ukiah in the Arbuckle coal field. These coal deposits have been explored in the past, with little indication that the deposits on National Forest System lands are of economic value. There are no active, proposed, or anticipated coal mining or coal bed methane operations on National Forest System lands.

Geothermal resources exist throughout the Blue Mountains, revealed by numerous hot springs and warm water wells. The U.S. Department of Energy (USDOE 2003) reported the potential for occurrence and development of geothermal resources in northeast Oregon is rated moderate to high, indicating there may be potential for leasing of geothermal resources on Forest Service lands. However, geothermal resources on Forest System lands in the Blue Mountains are not well documented compared to areas surrounding the national forests. The Geothermal Information Layer for Oregon (http://www.oregongeology.org/sub/gtilo/background.htm) lists 110 springs and 1,350 wells in or near the Blue Mountains, of which 8 springs and 10 wells are located on the national forests. Available data for Washington (https://www.dnr.wa.gov/programs-and-services/geology/publications-and-data/gis-data-and-databases) lists 5 springs and 11 high geothermal gradient wells in the northern Blue Mountains, none of which are located on the national forests. In Washington and Oregon combined, fewer than 7 percent of known geothermal springs and fewer than 1 percent of geothermal wells are located on National Forest System lands in the Blue Mountains.

Saleable or common variety mineral resources exist throughout the Blue Mountains. The abundance of basalt and andesite formations in many areas make this type of resource readily available, but there are some areas of the National Forests where high quality materials for construction or road aggregates are rare and not locally available.

Locatable mineral resources, such as gold, silver, copper, chrome, zinc, and other metals, have been produced from placer and lode mines in the Blue Mountains area. While locatable minerals are found on all three National Forests, they are primarily concentrated in a broad linear path beginning southwest of John Day, and extending northeast through Sumpter, Granite, Unity,

Baker City, across to Durkee, Halfway, through the Eagle Caps, and exposed in the bottom of Hells Canyon. These locatable mineral deposits are closely associated with Jurassic age intrusive rocks.

Areas with potential for wind energy development have been mapped for northeastern Oregon and southwestern Washington by the U.S. Department of Energy. The most extensive areas with wind energy development potential occur outside the national forests rather than within them. Many areas outside of the forests have experienced wind energy development in recent years. The areas with highest potential for development on National Forest System lands are generally found at higher elevation, on ridgelines or other open areas, and many of these areas are likely to be either legally excluded from development or within management areas with limited suitability for placement of wind towers and associated utility lines.

Changes Made Between the Draft and Final Environmental Impact Statements

Aside from changes described in the Preface to this document, the following changes were made specifically to this section:

Revised Forest Plan Content: Guidelines were modified for leasable minerals and locatable materials concerning federally listed and sensitive species. These guidelines provide additional guidance for mineral lease activity and provide reference to Forest Service regulations for locatable mineral activity (36 CFR 228).

Multiple guidelines were developed under the Special Uses section (Section 3.3.3) to better address potential wind energy uses on the forests. Wind energy analyses were improved.

A standard was developed that provides additional information regarding forest transportation system roads and mineral activity.

A standard was developed to provide guidance for vertebrate fossils.

Changes Made to the Environmental Analysis: The discussion of mineral resources has been updated to provide additional background description of the geology of the area, potential for development of leasable minerals, including oil and natural gas, and describe the process requirements for development of oil and natural gas.

The section on "Geothermal Resources" has been updated to better describe the distribution, occurrence, and potential for development of geothermal resources.

The description of locatable minerals has been revised in response to public comment. Additional background is provided to describe the types of mineral deposits and the areas that they are known to occur.

Geology, Mining, Minerals, and Energy – Affected Environment

Leasable Mineral Resources

Oil and Natural Gas

Oil and natural gas resources are known to occur within Mesozoic-age sedimentary rocks in the Columbia basin of Oregon and Washington in areas overlain by up to three miles of Columbia River basalt making exploration and development costly. Together, the Columbia and Central

Oregon Mesozoic basins underlie all or parts of 14 counties in central and eastern Oregon (DOGAMI 1989); in addition, the Columbia basin underlies much of eastern Washington. Parts of this resource are thought to underlie the Malheur and Umatilla National Forests and parts of the Wallowa-Whitman National Forest. Natural gas production is currently occurring in western Idaho from a gas field located between Weiser and Caldwell, Idaho. Production occurs from Miocene to Pliocene (8.5 to 2.0 million years old) lacustrine strata of the Idaho Group (Wood 1994), a strata that extends into eastern Oregon near Vale. The only other production to date occurred in the 1930s occurred in the vicinity of the Pasco, Washington, in an area known as the Yakima fold belt.

Cretaceous marine and fluvial-deltaic sedimentary rocks exposed near Mitchell, Oregon are believed to be potential source rocks for hydrocarbons and have a total thickness exceeding 9,000 feet (Oles and Enlows 1971), while the thickness of the entire sequence of Cretaceous to Tertiary sediments exceeds 19,000 feet (Wilkinson and Oles 1968). Exploration in the basin is made more difficult by thick sequences of the overlying Columbia River basalt which are exposed at the surface over much of the basin (Tennyson and Parrish 1987). Near Mitchell, Oregon and including the John Day Fossil Beds, sedimentary rocks of Mesozoic and younger age are overlain by as much as 1,000 feet of Columbia River basalt. In eastern Washington, the thickness of the overlying basalts exceeds three miles, and locally may exceed seven miles (Catchings and Mooney 1988).

Potential hydrocarbon reservoirs occur throughout the Columbia basin which was complexly folded both before, during, and after eruption of the Columbia River basalts (Taylor 1960, 1981; Camp and Hooper 1981; Reidel et al. 2013).

There is some indication the area of highest potential for occurrence of economic deposits is in central Washington (Tennyson and Parrish 1987), including a study the U.S. Geological Survey (2008) which suggested that up to 90 percent of potential gas resources may be in Pasco Basin of eastern Washington. Based on that assessment, the potential for occurrence of gas oil resources on the National Forest System lands in the Blue Mountains is moderate to low, and the development potential is likely low to very low, at least in the near future, and as long as more productive basins exist elsewhere in the U.S. It is possible that knowledge of the productive potential of the Columbia Basin for oil or natural gas could change in the future with the discovery of an economic deposit, as such a discovery would likely lead to increased exploration interest in the basin.

The Oregon Department of Geology and Mineral Industries records indicate a number of exploratory permits have been issued in Grant, Harney, Baker, and Umatilla counties, mostly in the 1950s. For some of these sites the records are incomplete, but none of them are known to have been on National Forest System lands, or successfully developed into production wells. There are no current or pending leases for gas or oil exploration on the any of the three national forests of northeastern Oregon and southeast Washington.

The Forest Service has made oil and gas leasing decisions for parts of the Umatilla National Forest outside of the Snake River Basin and all of the Malheur National Forest (USDA Forest Service 1995), which categorized all of those lands as either (i) open to development subject to the terms and conditions of the standard oil and gas lease form, (ii) open to development but subject to additional constraints, or (iii) closed to leasing, distinguishing between those areas that are closed through exercise of management direction, and those closed by law, regulation, etc. (36 CFR 288.102 (c)), such as wilderness areas and wild river corridors.

For the Umatilla and Malheur National Forests, all lands classified no lease in the 1995 leasing analysis and record of decision should be classified as unsuitable for oil and gas development. All other lands would be classified as generally suitable, although more recent information suggests that development potential on these lands is likely low to very low. Portions of the 1995 leasing decision may need to be revisited prior to leasing, due to potential significant new information or circumstances as defined in 40 CFR 1502.9 requiring further analysis (36 CFR 228.102(e)).

For the Wallowa-Whitman National Forest, all existing wilderness areas and wild river corridors would be classified as unsuitable for oil and gas development. Areas that are outside of existing wilderness areas and wild river corridors would be classified as general suitability not determined because an oil and gas leasing analysis and decision for the forest has not yet been made. Available information suggests that development potential for oil and natural gas within the Wallowa-Whitman National Forest is low.

Coal

To date there has been very little coal development on National Forest System lands in the Blue Mountains. Coal deposits are known in the Troy and Flora areas, and west of Ukiah in the Arbuckle coal field. These coal deposits have been explored in the past, with little indication that the deposits on National Forest System lands are of economic value. There are no active, proposed, or anticipated coal mining or coal bed methane operations on National Forest System lands.

Geothermal Energy

The Geothermal Steam Act of 1970 added geothermal resources to the list of leasable resources on Federal lands. A report by the U.S. Department of Energy (USDOE 2003) identified all areas of the Malheur, Umatilla, and Wallowa-Whitman National Forests as having medium to high potential for geothermal resource development (USDOE 2003). The USGS further defines moderate-temperature (90° to 105°C; 194° to 302°F) and high-temperature (greater than 150°C) geothermal systems (USGS 2008).

Section 222 of the 2005 Energy Policy are requires “All future forest plans and resource management plans for areas with high geothermal resource potential shall consider geothermal leasing and development.” As evidenced by the presence of hot springs throughout the Eastern Oregon, temperature gradients are relatively high when compared to most continental lands.

Some of the better known hot springs in the Blue Mountains National Forests area include the Blue Mountains Hot Springs near Prairie City, Medical Springs east of North Powder, Hot Lake Springs near La Grande, Radium Hot Springs near Haines, Ritter Hot Springs near Ritter, Suplee Hot Springs near Weberg, and Lehman Hot Springs between Ukiah and La Grande. None of these hot springs emerge on National Forest System lands, but some are very close to the national forest boundaries, and Lehman Hot Springs is on a private inholding within the Umatilla National Forest and represent higher than normal geothermal gradients in the area. There are other known geothermal springs located on National Forest System lands. Geothermal areas with known high temperature water (greater than 90 degrees Celsius or 194 degrees Fahrenheit), either near the land surface or at depth, may have higher development potential than other geothermal resources. In the vicinity of the Blue Mountains, the areas mapped as having known or potential high temperature geothermal sources are near Vale, Oregon and Hot Springs Lake near La Grande, Oregon (NREL 2009). There are no other commercial high temperature geothermal areas developed in northeastern Oregon or southeast Washington. However, emerging technologies are

now be utilized to provide direct use geothermal heating to work and living space at much lower temperatures than needed to generate electricity. Uses include "…district heating, greenhouses, fisheries, mineral recovery, and industrial process heating." Some low-temperature resources are being used to the generate electricity using binary cycle electricity generating technology. As these technologies become increasingly practical, increased demand for geothermal resources on and near the Forests may occur.

The Oregon Department of Geology and Mineral Industries records indicate that two permits for geothermal exploration were issued in Union County in 1974. One was cancelled and records for the other are incomplete, but neither are known to have been on National Forest System lands, or successfully developed into production wells. There have been many permits issued in eastern Oregon by the Department of Geology and Mineral Industries since the 1990s, but all of those have been issued in Deschutes, Harney, Lake, and Klamath counties. Today, there are no geothermal leases within the Blue Mountains National Forests. Consequently, an analysis to consider the effects of geothermal leasing will be completed as the need arises.

As with oil and gas, geothermal leasing of National Forest System lands can only occur with the consent of, and subject to conditions prescribed by, the Secretary of Agriculture. All lands administered by the Secretary of Agriculture (including all National Forest System lands) are subject to geothermal leasing (30 U.S.C. 1002), subject to certain prohibitions. Forest Service consent for BLM to lease geothermal resources for any of the Forests, covered by this analysis, would be based on specific land management prescriptions. Stipulations determined in the consent analysis to be necessary and appropriate to protect the lands and resources involved would be applied as enforceable lease terms by the BLM.

Locatable Minerals

Locatable mineral exploration and development from National Forest System lands is authorized under the General Mining Law of 1872, as amended. Historically, about 75 percent of all of the gold mined in Oregon has come from within broad zone extending from Canyon Creek, near John Day, Oregon, north across the Middle and North Forks of the John Day River to the vicinity of Granite, Oregon and east across the Elkhorn Mountains and the southern Wallowa Mountains to the Snake River. Placer mining has occurred in Canyon Creek, the Upper, Middle and North Forks of the John Day River, North Fork and lower Burnt River, Eagle Creek and Pine Creek, and the upper Grande Ronde River. Each of these areas is associated with, or downstream of major areas of past gold production (Ferns and Huber 1984). Gold mineralization in the Blue Mountains may have resulted from multiple geological sources, but many of the areas of gold mineralization are associated with late Jurassic and older granitic rocks (Ferns and Huber 1984).

Gold has been produced from placer deposits and hard rock or lode deposits within and outside of the National Forest System lands. Many claims were patented under the General Mining Law of 1872, as amended, whereby they became privately owned land within the national forest boundaries. Mining activity in this area became relatively large scale in the early 1860s, with the most active period between 1895 and 1908. There were intervals where activity increased and decreased up until about 1954, after which production dropped of drastically. Exact figures were never recorded for early gold production from the Blue Mountains, as much of the gold was sent to a mint in San Francisco and was credited to California. But it has been estimated that approximately $23 million in placer gold and $5 million in lode gold had been produced from mining operations in Grant and Baker counties by 1900. The estimated dollar value for placer and lode gold produced from the area between 1900 and 1965 is $47 million (Orr and Orr 2000).

Ferns and Huber (1984) estimated gold production of 480,000 ounces from placer mining 1913 and 1954; about 60 percent of that production came from the upper Powder River.

Gold and silver are often found within the same lode ore deposits. $2 million dollars of silver is estimated to have been produced from within the Blue Mountains between 1900 and 1965. There has also been some production of copper, mostly from the Iron Dyke mine near Homestead, as well as small amounts of chrome, zinc, and other metals from mines within the Blue Mountains national forests. There are also many isolated gold and other metal deposits, including mercury, which were discovered and mined outside of the main mineralized areas in the Blue Mountains. These isolated deposits include the Idol City Mining District northeast of Burns, the Roba-Westfall, Roba Brothers, and York and Rannels mercury mines southwest of John Day, and others.

Locatable mineral exploration and development is often dependent upon the supply and price of global mineral commodities; however, economic conditions and availability does not often affect the number of mining claims and approved operations for small-scale mining operations. Most of the modern mining activity in the Blue Mountains is conducted be small-scale miners. According to Bureau of Land Management records as of March of 2011, the Malheur National Forest had 84 locatable mineral claims, the Umatilla National Forest had 34, and Wallowa-Whitman National Forest had 748. Approved plans of operation are required to conduct exploration or mining operations on National Forest System lands. When the District Ranger determines a Plan of Operations submitted for exploration or mining on National Forest System lands may cause significant disturbance, an environmental analysis of the effects of implementing the Plan may be required. In 2016, 28 plans of operation were approved in the Granite Mining Record of Decision and 42 plans of operation were approved with the North Fork Burnt River Record of Decision. An additional 23 plans of operation are pending approval by the Powder Mining Environmental Impact Statement, which is in progress.

Certain areas, where resources or capital investments are determined to warrant additional protection, not provided by law or Forest Service regulations, may be withdrawn from entry under the General Mining Law. However; when valid existing rights are established prior to the date of withdrawal, the holder of those rights may conduct exploration and mineral development activities within the boundaries of their validated mining claim(s). Procedurally, lands are withdrawn from mineral entry, under a public land order issued by the Secretary of the Interior as provided in Sec. 204 of the Federal Land Policy and Management Act. Withdrawals are subject to renewal or expire at the end of the withdrawal term under BLM regulations found in Chapter 43 of the Code of Federal Regulations 2300.

Saleable Minerals

Saleable or common variety mineral resources exist throughout the Blue Mountains. These are usually low unit value materials and typically need to be located both near existing transportation routes and the point of use to be economically viable. In northeast Oregon, basalt and andesite are commonly used as construction materials and road aggregates, because they are readily available. These rock types are abundant in many areas of the national forests but scarce to nonexistent in other areas where other rock types may be used despite having less desirable qualities. There are also some deposits of sand, gravel, limestone, and rock suitable for landscape or building stone that occur within the national forests.

The National Forests have an extensive network of common variety materials sources that were developed over time in conjunction with development of national forest transportation systems.

The total number of these sources on the three Blue Mountains national forests probably exceeds 500, but many are considered inactive or have not been used for many years. Some of the sources are located near state and Federal highways or major county roads and have been used extensively by those agencies as well. Use of these types of sources is down dramatically compared to when the national forest transportation systems were being rapidly expanded. They are still used intermittently by the national forests for in-service uses, and a few sources are still used frequently by other government agencies, usually through issuance of free-use permits.

Common variety minerals are also available through the issuance of small free-use permits to individuals or sales to private parties for personal or commercial uses, but the amount of materials disposed of through these permits is usually relatively minor.

Sales, free use, or in-service use of mineral materials would not meet the management objectives of withdrawn National Forest System lands, inventoried roadless areas, and areas of unique or special characteristics. These lands would be categorized as unsuitable for mineral material development. All other lands would be classified as generally suitable. Some expansion of the boundaries or size of active common variety minerals sources is likely to occur in the next 10 to 15 years, but the development of new sources is expected to be relatively rare unless an unforeseeable demand should occur.

Wind Energy

The Energy Policy Act of 2005 encourages energy development in acceptable areas, including on Forest Service lands. Wind energy development in the Pacific Northwest has increased recently, as evidenced by wind tower installation at sites along the Columbia River in Oregon and Washington, in Baker Valley, and several other sites surrounding National Forest System lands in northeast Oregon and southeast Washington. Currently, there is no wind energy development on the Forests. If location and development of wind towers on National Forest System lands occurs in the future, it will be guided by provisions of the Forest Service Special Uses Handbook.

In the Blue Mountains region, areas with potential for wind energy development mainly occur outside of the Blue Mountain national forests. The Forest Service lands with highest potential for wind project development are generally found at higher elevation, on ridgelines, or other open areas. However, many sites with high potential for wind development are also likely to be within management areas that are not suitable for placement of wind towers and associated utility lines.

Suitability for Wind Energy Development (All Alternatives)

Wind energy potential maps were developed by the U.S. Department of Energy, National Renewable Energy Laboratory (NREL) in 1986 (http://rredc.nrel.gov/wind/pubs/atlas/). For the Blue Mountains area, NREL estimated 388,500 acres on National Forest System lands that exhibit a wind power classification that may be adequate for further evaluation and development. This includes 39,000 acres on the Malheur National Forest, 168,500 acres on the Umatilla National Forest, and 181,000 acres on the Wallowa-Whitman National Forest. Wind energy development will be generally unsuitable on sites where development is incompatible with desired conditions, where unacceptable impacts cannot be mitigated, or in areas where development is legally excluded, such as in in Congressionally Designated Wilderness Areas. The following criteria were used to determine general suitability of particular management areas for wind development on National Forest System lands.

- Forested sites, areas with slopes less than 20 percent, and valley bottoms generally do not have high wind exposure and will likely have low wind power development potential.

- Designated wilderness areas, proposed or potential wilderness areas, wild and scenic river corridors, and inventoried roadless areas are either legally excluded from wind energy development or are areas where wind energy development would be limited by available road access, and new road construction would be inappropriate.
- Areas with existing high scenic value within Scenic Classes 1, 2, and 3 are unsuitable due to the desire to maintain scenic integrity.
- Key watersheds may or may not be excluded due to a limitation on increasing road density above current levels.
- Municipal watersheds are guided by existing agreements between the agency and individual cities. Energy development would require approval by the cities and development could only occur under the provision that drinking water quality is protected.
- In some areas, for example in elk winter or summer range, motor vehicle access is limited during specific time periods. This limitation may not by itself determine suitability of a site for development, but may influence how sites are developed, and would place seasonal restrictions on motor vehicle access.
- Botanical areas are managed to preserve specific vegetative characteristics. Disturbance that would degrade these characteristics, including but not limited to siting of utility corridors or placement of high-voltage power lines, would not be a compatible use.
- Geological areas are managed to preserve specific geological features and development that could degrade these features would not generally be allowed.
- Motor vehicle use is generally not allowed within research natural areas and motor vehicle access would not be appropriate in the Starkey Experimental Forest and Range.
- Access or proximity to existing utility corridors and, more specifically, high-voltage power lines may be a prerequisite for development.

Wilderness areas (MA 1A), proposed recommended wilderness areas (MA 1B), wilderness study areas (MA 1C), wild and scenic rivers (MA 2A), and backcountry areas (MA 3A and 3B) would be generally unsuitable for wind energy development because such use would either conflict with the purpose for which an area was designated, or would be inconsistent with the intended uses of the area. Wind energy development in special areas (MA 2A through MA 2J) would normally be inappropriate, with few exceptions, as such development would likely be inconsistent with the intended use, or would be difficult to implement while still protecting the intended use of each area. Administrative sites may or may not be suitable sites for placement of individual wind towers but would likely not be suitable sites for commercial-scale wind farms.

Areas of the National Forests that are likely to be suitable for wind development will generally be in MA 4A General Forest. Areas within MA 4A with wind resources that may be adequate for development include 9,505 acres on the Malheur National Forest, 79,104 acres on the Umatilla National Forest, and 33,184 acres on the Wallowa-Whitman National Forest. Other considerations that may restrict this suitable area even further on the National Forests include:

- Cultural resource protection
- Protection of treaty and tribal trust resources
- Scenic integrity
- Protection of wildlife habitat

- Elk habitat, including summer and winter range, and elk calving areas
- Lookouts and communications sites
- Protection of threatened, endangered, and sensitive species
- Unstable sites
- Proximity to or ability to construct utility lines
- Road access

Additional protection measures for individual resources may exclude additional areas from consideration, based on project-level analysis. Oregon, Washington, Idaho, U.S. Fish and Wildlife Service, U.S. Bureau of Land Management, and U.S. Department of Energy all have siting criteria and other information that can be used in the assessment of wind energy projects.

Other Geologic Resources

Fossils

Invertebrate and plant fossils, and some vertebrate fossils, are known to occur in sedimentary rocks and ash deposits within the National Forest System lands in the Blue Mountains. Invertebrate marine fossils are common in some of the Jurassic and Triassic formations in sedimentary and meta-sedimentary rocks, and typically include ammonites and bivalves. The occurrence of vertebrate fossils is known in the geological sequence of rock formations in which the John Day Fossil Beds occur, but vertebrate fossils in older formations are less well documented. The most notable occurrences are an Ichthyosaur (a marine reptile) fossil from the Triassic Martin Bridge Limestone near Eagle Creek within the Wallowa-Whitman National Forest (Orr 1986), and the upper jaw of a Jurassic reptile, tentatively identified as a small crocodile, discovered in 2010 near Delintment Lake in a marine sandstone deposit on the Emigrant Creek Ranger District of the Malheur National Forest.

The John Day Fossil Beds National Monument, located west of the Blue Mountains National Forests, is famous for its plant and animal fossils from the Clarno and John Day Formations. Vertebrate fossils, such as dogs, cats, camels, rhinoceroses, horses, turtles, and others have been found there.

Current guidelines relative to fossils are based largely on the Organic Act of 1897, the Preservation of American Antiquities Act of 1906, the Paleontological Resources Preservation Act, Federal Land Policy and Management Act, the Surface Mining Control and Reclamation Act and Forest Service regulations published at Chapter 36 Code of Federal Regulations Part 291 (36 CFR 291.10 -13. Regulations governing collection of paleontological resources are found at 36 CFR 291. Vertebrate fossils (bones, bone fragments, teeth, and/or tracks) are not available for collection by the public, and commercial fossil collection is not permitted on any National Forest System lands. Collection of vertebrate, invertebrate, plant, and/or trace fossils as part of scientific studies, mitigation or conservation efforts is allowed only by qualified researchers that have been issued permits for specific projects or research (see 36 CFR 291.14).

Petrified Wood

Petrified wood is known to occur in many localities on the Blue Mountains national forests, including within the Clarno Formation and in some formations with deep volcanic ash deposits. Portions of standing petrified trees have been discovered in a few locations. Petrified wood is defined as a mineral material with 1962 amendment to the Mineral Materials Act of 1947. Regulations for the collection of petrified wood on NFS lands are found at 36 CFR 228.62(e). No

permit is required to collect petrified wood specimens for amateur collectors and scientists for limited quantities of material provided that such collection does not result in the disturbance of archaeological resource.

Groundwater

Groundwater potential is largely unexplored and undeveloped in the National Forest System lands of the Blue Mountains National Forests. The groundwater potential can be assumed to be highly dependent on the hydrogeological and geologic properties of local and regional formations. For example, metamorphic and the older volcanic formations would generally have low permeability aquifers with low hydraulic conductivities, and many wells in these materials would usually yield only a few gallons per minute. On the other hand, the younger volcanic rocks, and in particular the Columbia River Basalts, have been heavily developed on private lands around Hermiston, Pendleton, Athena, Milton-Freewater, Walla Walla and in the Grande Ronde Valley in Union County. Irrigation wells completed in each of these areas typically yield between 500 and 2000 gallons per minute. Withdrawal from the basalt aquifers in some areas of this formation have caused local water level declines up to or exceeding 300 feet (Snyder and Haynes 2010).

Groundwater resources have seen very minor exploration and development on the National Forest System lands of the Blue Mountains National Forests to date. Small volume wells for campgrounds and administrative sites are currently the most common uses of groundwater within the national forests. There are also a few wells that were drilled specifically for fire suppression and road construction and maintenance activities within the portion of the Ochoco National Forest administered by the Malheur National Forest. The Malheur National Forest has issued about 20 domestic water supply special use permits, and there are numerous spring developments for stock watering as well.

Geology, Mining, Minerals, and Energy – Environmental Consequences

Indirect and Cumulative Effects Common to all Alternatives

Energy and mineral development can have significant effects to physical and biological resources. Those effects are discussed in other sections of this document. The alternatives vary in their influence on mineral, geological, and energy resources primarily through differences in management area designation, as follows.

Leasable Minerals

Oil and Natural Gas

Approximately 1.2 million acres of the Umatilla National Forest and 1.35 million acres of the Malheur National Forest were identified as available for oil and gas leasing (USDA Forest Service 1995). These lands are subject to one of four lease stipulations imposed to protect surface resources. Under the Federal Onshore Oil and Gas Leasing and Reform Act of 1987 (P.L. 100-203), identification of lands available for leasing is the first of four required stages, each requiring a separate environmental analysis, before energy production can occur on National Forest System lands. However, the lands identified in the 1995 analysis were not formally made available for lease; at least parts of that analysis should be revised using the management area designations of the selected alternative. In 1995, it was predicted that one application for permit to drill could be received on each National Forest. This did not occur and it is unlikely an application for permit to drill would be expected over the next 10 years given the updated information now available on

the potential occurrence of oil or natural gas. The predicted potential for discovery and development of oil and gas resources beneath the Malheur and Umatilla National Forests is lower now than it was believed to be in 1995. Exploration interest in the resource may increase if a discovery is made in the area of the basin with the highest potential for occurrence (the Pasco Basin).

For rivers identified as eligible for inclusion in the National Wild and Scenic River System, the Forest Service would provide recommendations or consent to BLM stipulating any leases, licenses or permits issued under mineral leasing laws for the protection of the identified values of each river corridor. Rivers officially determined to be eligible and suitable for wild and scenic designation cannot be legally excluded from mineral entry (except within a ¼ mile corridor of either side once they are officially designated). Eligible rivers may be stipulated that no surface occupancy is allowed for mineral leasing. The rivers to which this would apply are listed in Table 399 on page 446.

The acres of preliminarily administratively recommended wilderness areas on each forest are identified in Tables 108-110 (FEIS Volume 1). Total recommended wilderness acres for each forest are summarized by alternative in Table 111 of Volume 1. No change in the status of these lands, or their availability for mineral leasing would occur until they are recommended, and officially designated as wilderness by Congress. At that time they may be legally excluded from leasing. There would be no effect from Alternatives A or D, since they do not include any recommended wilderness acres. A total of up to 2,600 acres on the Umatilla and Malheur National Forests, would be legally excluded from oil and gas leasing under Alternative B, 332,300 acres under Alternative C, 70,500 acres under Alternatives E and F, and 58,500 acres under Alternatives E-Modified and E-Modified Departure.

No direct or indirect effects would occur due to oil and gas leasing and development until such time as specific lands are actually made available for leasing, the effects of leasing specific lands are analyzed, application of permit to drill is issued, and drilling actually occurs. The effects of each of these actions would be assessed in separate analyses.

Geothermal Energy

No known areas with high potential for geothermal development that could be utilized for electricity generation are known to occur on National Forest System lands in the Blue Mountains. Potential for low and moderate geothermal resources occurs throughout the analysis area. It is unlikely that there would be any effect to the potential for development of geothermal energy from any of the alternatives. There could be indirect effects to National Forest System lands or to groundwater underlying national Forest Systems lands due to development of geothermal resources on lands adjacent to the national forests.

Locatable Minerals

National Forest System lands are open to mining except those specifically withdrawn from mineral entry. The forests each have a responsibility to identify areas with resources values and capital investments which could be negatively or irreparably affected by mineral exploration and mining activities. National forests that identify areas that may not be adequately protected by existing law or agency regulations must prepare an application and follow the process identified by the Secretary of the Interior and BLM regulations to withdraw the lands from minerals entry.

For rivers identified as eligible or suitable for inclusion in the National Wild and Scenic River System, mineral entry would be subject to the conditions necessary for the protection of the

values of each identified river corridor in the event it is subsequently included in the national system. New mining claims would be prohibited on eligible or suitable wild rivers once those rivers are officially designated and legislatively withdrawn. The rivers to which this would apply are listed in Table 399 on page 446.

No change in the status of lands identified as recommended wilderness, or their availability for mineral entry would occur until they are recommended, and officially designated as wilderness by Congress. At that time, the mineral potential of each designated area would be evaluated and withdrawn from mineral entry as directed by Congress.

Saleable Minerals

The disposal of saleable minerals is a discretionary decision of the local district ranger, but may be allowed on eligible or suitable scenic or recreational rivers to protect the values for which individual rivers were deemed eligible. Pit development would be prohibited within ¼ mile of eligible or suitable wild rivers once those rivers are officially designated. No eligible or suitable rivers are identified for alternative A. The miles of eligible rivers are the same for all alternatives on the Malheur National Forest (3.3 miles classified as wild). The miles of eligible rivers for the Umatilla National Forest for Alternatives B, C, D, E, and F are 72 miles classified as wild and 42 miles classified as scenic or recreational; and Alternatives E-Modified and E-Modified Departure are 57 miles classified as wild and 59 miles classified as scenic or recreational. On the Wallowa-Whitman National Forest 65 miles of eligible rivers are classified as wild and 96 miles as scenic or recreational rivers in Alternatives B and C; and 14 miles of suitable rivers classified as wild and 19 miles of suitable rivers classified as scenic or recreational in Alternatives D, E, E-Modified, E-Modified Departure, and F.

Wind Energy

The suitability for development of wind energy on National Forest System lands varies primarily by management area designation. The suitability of management areas for wind energy development is displayed in tables A-19 through A-23 in appendix A. Because wind energy development would require a special use permit, the direct, indirect and cumulative effects of a new wind energy project would be evaluated in a project-level analysis before any permit would be issued.

Average annual wind resources were estimated for the nation by NREL. For the Blue Mountains area, NREL estimated 388,500 acres of national forest lands (39,000 acres within the Malheur National Forest, 168,500 acres within the Umatilla National Forest, and 181,000 acres within the Wallowa-Whitman National Forest) exhibit a wind power classification that may be adequate for further evaluation and development. However, based on a preliminary analysis by Gecy (2010) of the NREL wind resources compared to suitability of management areas on each forest for wind development, approximately 2 percent of National Forest System lands, or 122,000 acres, may be suitable for wind development. For the most part, these areas are located in areas of high wind exposure, and are often on ridgelines. Forested areas, valley bottoms, and other areas with low wind exposure, by their nature, have low wind energy potential. Additional limitations could reduce the availability of potentially suitable areas further, but would not be determined until a specific project analysis is completed. The acres suitable for wind energy development would be similar among the alternatives but slightly lower in alternatives that recommend more areas of designated wilderness or additions to the Wild and Scenic River System (Alternative C) and greater in the alternatives that would add the fewest acres to these designations (Alternative D).

Fossils

Collection of invertebrate and plant fossils for personal use is allowed on National Forest System lands, but casual collection of vertebrate fossils is not allowed by Federal law. Scientific collection of vertebrate fossils is allowed under permit. This will not change regardless of the alternative selected. The ability to access potential collection sites by motor vehicle would be most limited under Alternative C because it has the highest number of acres of areas in which motor vehicle use would be restricted, but access to sites would otherwise not be limited under any of the alternatives.

Groundwater

Potential effects of the alternatives on groundwater uses are discussed in the "Watershed Function, Water Quality and Water Uses" section of this document.

Cumulative Effects

The cumulative effects analysis area includes all of northeastern Oregon, southeastern Washington, and western Idaho, including all of the Malheur, Umatilla, and Wallowa-Whitman National Forests, and the time period considered was the planning period. All mineral resources on all three national forests would be administered in accordance with laws, regulations, and Forest Service policies and management direction.

Section 11 of the Hells Canyon National Recreation Area Act states: "Notwithstanding the provisions of section 4(d)(2) of the Wilderness Act and subject to valid existing rights, all Federal lands located in the recreation area are hereby withdrawn from all forms of location, entry, and patent under the mining laws of the United States, and from disposition under al laws pertaining to mineral leasing and all amendments thereto." The Hells Canyon National Recreation Area Comprehensive Management Plan the Hells Canyon National Recreation Area Act include additional regulatory and statutory direction for mineral resources.

No cumulative effects are expected to occur from the development of oil, natural gas, or geothermal leasing. Leasing of National Forest System lands for these resources is possible but not expected during the planning period. Available information suggests that the possibility of development of oil and natural gas resources on the national forests in the Blue Mountains is limited, at least until an economic discovery occurs in the Columbia Basin. The potential for development of geothermal in the Blue Mountains was rated as moderate to high by the Department of Energy (2005), but the most recent assessment provided by the Argonne National Laboratory (Zvolanek et al. 2013) suggests that the potential for development of geothermal resources on national forests in the Blue Mountains varies spatially, and is rated as low to moderate where it exists.

The development of locatable minerals, primarily gold, will continue on the national forests in areas that are available to mineral entry under the mining laws of the United States. The direct, indirect, and cumulative effects of mineral development of individual mines and plans of operation have been or are being addressed in area-wide environmental analyses (such as the Granite Mining, North Fork Burnt River Mining, and Powder Mining Environmental Impact Statements). The Forest Service retains the authority determine the measures needed to protect surface resources. All alternatives contain standards and guidelines that affect mineral operations that are similar to what currently exists under PACFISH and INFISH. Alternatives E-Modified and E-Modified Departure include a standard that requires mineral activities to avoid or minimize effects to threatened and endangered species.

The management, availability, and disposal of saleable minerals is not expected change under any of the action alternatives. There is one pending proposal on the Wallowa-Whitman National Forest for development of a new quarry. Development of the quarry and consideration of alternative sites has not begun as of January 2018. The environmental effects of development of the quarry would be based on a site-specific analysis and are not within the scope of this analysis.

No direct, indirect, or cumulative effects from development of wind energy on the national forests will occur until the feasibility of development on a specific site is determined and a project is permitted. Although the capability of wind generation exists on the three national forests, the feasibility of wind tower placement within the national forests is currently unknown.

The casual collection of invertebrate and plant fossils will continue to be allowed. The collection of vertebrate fossils will be allowed only by permit to qualified applicants. Collection of invertebrate and plant fossils that involves more than minimal surface disturbance may be allowed by permit, but could result in the closure of some sites to fossil collection.

Groundwater resources on the national forests could be affected by any of the activities in this section, but is more likely to occur in response to development of geothermal or oil and gas resources. No effects to groundwater is expected from these activities until completion of appropriate environmental analysis of an individual project and application for permit drill is granted. Effects to groundwater and surface water from the mining of locatable minerals are addressed through analysis of the effects of individual or grouped plans of operation.

Lands and Special Uses

Introduction

This section addresses landownership administration and adjustments and special uses of National Forest System lands on the Blue Mountains national forests.

Management of landownership includes survey and marking landlines and other boundaries, purchase and exchange of lands with private parties and non-federal government entities, handling of title claims and other assertions of title, and acquisition of rights-of-way.

Adjustments of land ownership can occur through congressionally mandated conveyances, exchanges, and acquisitions, or through Forest Service administrative activities.

The objectives of the Forest Service landownership adjustment program (FSM 5402) are to:

- Achieve the optimum landownership pattern to provide for the protection and management of resource uses to meet the needs of the nation now and in the future;
- Avoid land use conflicts with non-Federal landowners by settling land claims equitably and promptly; and
- Provide resource administrators readily accessible and understandable title information affecting the status and use of lands and resources they administer.

Land occupancy and use by private parties and other government entities is managed through the issuance of special use authorizations. Authorized special uses on the Blue Mountains national forests include industrial or commercial uses, private uses, and a variety of recreational uses.

All occupancy, use, or improvements on National Forest System lands that are not directly related to timber harvest, grazing, mining activities, and recreation are referred to as “non-recreation

special uses." Typically, non-recreation special uses includes: roads, utilities, easements, storage facilities, and agricultural improvements. Recreation special uses include: resorts, ski areas, outfitters and guides, and a variety of uses that provide access to National Forest System lands by commercial ventures.

Use and occupancy of National Forest System lands may be authorized when such use is determined to be in the public interest.

Changes Made Between the Draft and Final Environmental Impact Statements

The section presented below was developed for the Final Environmental Impact Statement. The information discussed and presented below was available and reviewed as part of the Draft Environmental Impact Statement, and has since been compiled into the current section for further review and analysis.

Lands and Special Uses – Affected Environment

Lands

The Blue Mountains national forests landownership pattern varies with location and can be characterized as:

- Large blocks of uninterrupted, contiguous National Forest System lands;
- Checkerboard situations with alternate sections of private and National Forest System lands;
- Isolated tracts of private lands surrounded by National Forest System lands;
- Isolated tracts of National Forest System lands surrounded by private lands; and
- Large blocks owned by corporate landowners.

Non-National Forest System lands are located within the proclaimed boundary of the Blue Mountains national forests and are comprised of state and local government, other agency, and corporate and private ownership.

Special Uses

Special use authorizations permit occupancy and use on National Forest System lands by federal, state, and local agencies, Indian Tribes, private industry, and individuals. Non-recreation special uses vary from low-intensity, often short-term actions such as filming or locations for scientific instruments, to larger developed facilities such as roads, communication sites, dams, and utility/energy transmission infrastructure.

As of 2014, there are approximately 620 special use authorizations in effect on the Blue Mountains national forests: 104 permits are authorized on the Malheur National Forest; 230 permits are authorized on the Umatilla National Forest; and 282 permits are authorized on the Wallowa-Whitman National Forest.

Lands and Special Uses – Environmental Consequences

Effects from Alternative A (no action)

This alternative reflects the 1990 Forest Plans, as amended to date, and accounts for current laws and regulations that have been issued since the original Forest Plans and the amendments were adopted. The 1990 Forest Plans recognized the desirability of adjusting landownership in order to improve manageability of National Forest System lands. This alternative does not propose to acquire or dispose of any lands but did identify lands that were desirable to be acquired and lands that were available for disposal (see 1990 Malheur National Forest Land and Resource Management Plan, Appendix M; 1990 Umatilla National Forest Land and Resource Management Plan, Chapter 4; and Wallowa-Whitman National Forest Land and Resource Management Plan, Appendix D).

Effects Common to the Plan Revision Alternatives

None of the alternatives proposes to make any site-specific changes to the existing landownership on the Blue Mountains national forests. No conveyances (acquisitions, disposals, or exchanges) are proposed. Any of these actions would only be considered at the project level. Until an external entity presents a proposal there would be no changes to the existing landownership pattern. Because no changes in landownership are proposed, the number of acres of NFS lands remains the same for all the action alternatives.

None of the alternatives proposes to make any site-specific changes to existing special use authorizations or rights-of-way on the Blue Mountains national forests. Because no changes in special use authorizations or in rights-of-way are proposed, there is no difference between Alternative A (no action) and the action alternatives.

Since 2009, the three national forest have undertaken additional land acquisition and land exchange activity. Specifically, the Malheur National Forest has acquired 13,085 acres through one land acquisition project; the Umatilla National Forest has acquired 1,185 acres and disposed of 491 acres through four separate land acquisition and exchange projects; and the Wallowa-Whitman National Forest has acquired 1,225 acres through five separate land acquisition and exchange projects. None of these acquired areas are included in the acreage totals or the analysis for this Environmental Impact Statement. Each area will be further analyzed through subsequent project planning and site-specific analysis, including regulations at 36 Code of Federal Regulations Part 254.3 (e) and (f). Similarly, these acres did not contribute toward the total acreages regarding timber and range suitability determinations, as these determinations will be made through future site-specific analysis.

Consequences to Lands and Special Uses from Forest Plan Components Associated with other Resource Programs or Revision Topics

Effects from Management Area Prescriptions

Some MA allocations, such as National Forest System lands which have been statutorily designated for a specific use (e.g., Management Area 1A – Congressionally Designated Wilderness Areas, Management Area 2A – Eligible Wild & Scenic Rivers) or lands that have been administratively designated for a specific use (e.g., Management Area 1B – Recommended Wilderness Areas, Management Area 2B – Research Natural Areas) are less likely to be considered for disposal or exchange. Based on Management Area allocations, Alternative C

would have the greatest number of acres that would be less likely to be considered for disposal or exchange, followed by Alternatives E and F, E-Modified and E-Modified Departure, B, and D.

Similar to lands, some special uses authorizations are less likely to be considered in Management Areas 1A, 1B, 2A, and 2B. Based on Management Area allocations, Alternative C would have the greatest number of acres that would be less likely to be considered for special use authorizations, followed by followed by Alternatives E and F, E-Modified and E-Modified Departure, B, and D.

Effects from Vegetation Management

Vegetation treatments may impact the appraised value of National Forest System lands, and depending on the type of treatment, the value may increase or decrease. Alternative D has the potential for the highest amount of vegetation treatment and is most likely to result in fluctuations in land values, followed by E-Modified Departure and Alternative E-Modified, E and F, B, and C.

Effects from Wildlife Management

National Forest System lands that provide secure habitat or contribute as linkage areas are less likely to be considered for disposal or exchange. Alternative C has the most area allocated to wildlife corridors, followed by Alternatives E and F, E-Modified and E-Modified Departure, D, and B.

Effects from Recreation Management

National Forest System lands with developed recreation sites (e.g., campgrounds) are less likely to be considered for disposal or exchange. None of the alternatives proposes to make any site-specific changes to existing designated campgrounds resulting in no difference between the alternatives.

Cumulative Effects

The cumulative effects analysis area includes all of northeastern Oregon, southeastern Washington, and western Idaho, including all of the Malheur, Umatilla, and Wallowa-Whitman National Forests, and the time period considered was the planning period. The Hells Canyon National Recreation Area, under the administration of the Wallowa-Whitman National Forest, was congressionally designated in 1975 and contains designations for the national recreation area along with additional wilderness and wild and scenic rivers designations. Section 9 of the Hells Canyon National Recreation Area Act (P.L. 94-199) contains additional considerations for land acquisition for lands within the National Recreation Area.

The Blue Mountains national forest’s landownership pattern will continue to be modified to accomplish Forest Plan desired conditions. Opportunities for improving the landownership pattern will likely continue and will be achieved through land exchanges, purchases, donations, transfers, interchanges, and disposal.

Private land transactions that either border or are located within administrative boundaries of National Forest System will likely continue. Such lands remain subject to State statutory frameworks, local government ordinances, and land planning and zoning regulations. These combined regulations will likely result in minimal changes to the character of private, state, and corporate land holdings surrounding National Forest System lands that may result from private land transactions.

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